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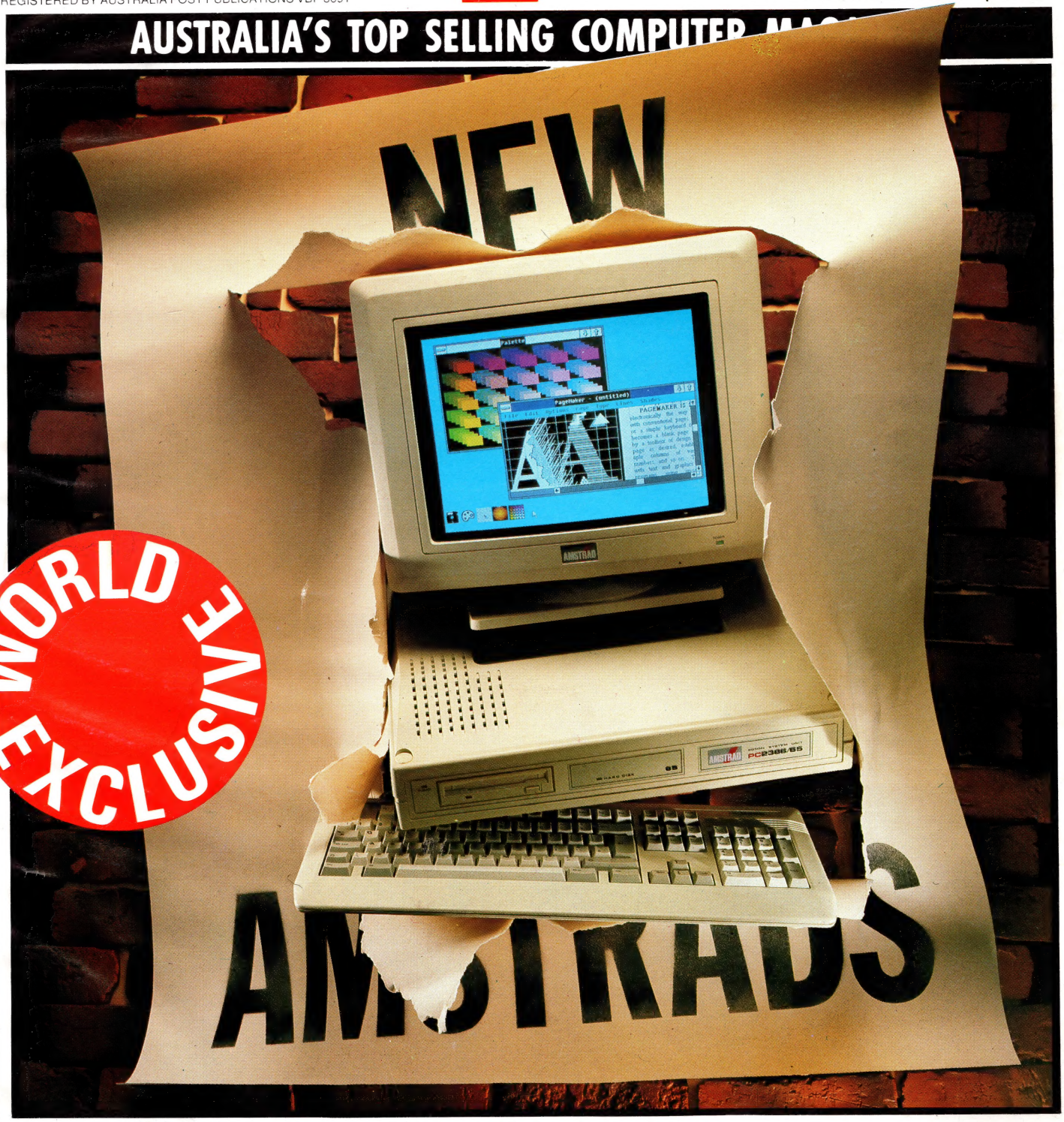
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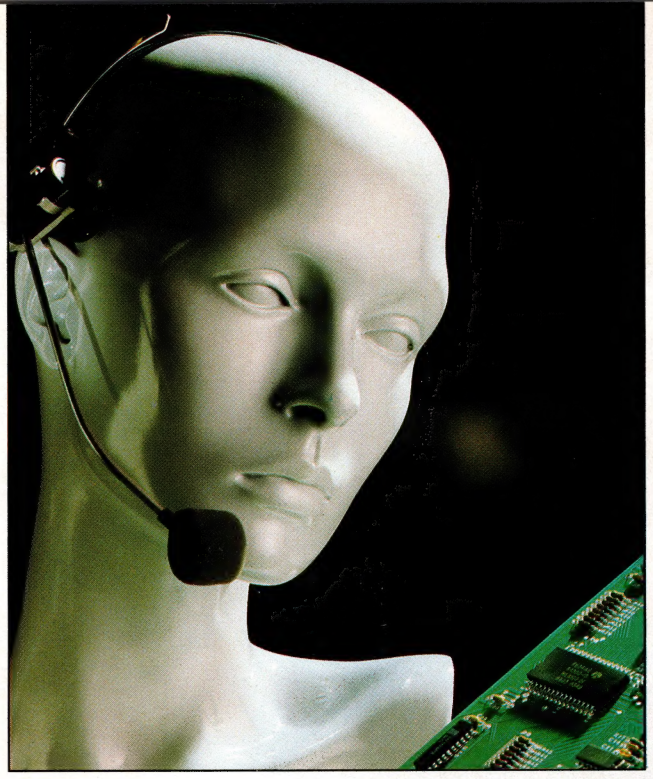
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CONTENTS

Volume 9 Number 10 October 1988



REGULARS

5 NEWSPRINT

APC's monthly round-up of microcomputing news this issue reports on how a number of PC manufacturers are ganging up against IBM and developing an alternative to the Micro Channel Architecture; Guy Kewney backpedals on his enthusiasm for Borland's Sprint; Apricot's surprise launch of a PS/2 clone range, which means it will be the first to deliver such machines to the Australian market; and Ashton-Tate announces more database products to impress the masses.

25 STATESIDE

Our US correspondent, Tim Bajarin, has been to MacWorld and reports back with news, among other things, of the best optical character recognition software yet, vastly improved character animation and an amazing new breed of music software.

183 BIBLIOFILE

Parallel programming is all the rage, but a little research first is probably wise.

187 AFTER DARK

Chris Cain dons his G-suit as his Amiga becomes an F16, but gets his come-uppance in a Yuppie adventure game.

263 TJ'S WORKSHOP

A dozen pages of insightful information on how to get more out of your computer.

291 COMMUNICATIONS

Steve Withers shows how to save time with the Australian product AutoDial, and presents the bulletin board update.

297 ENDZONE

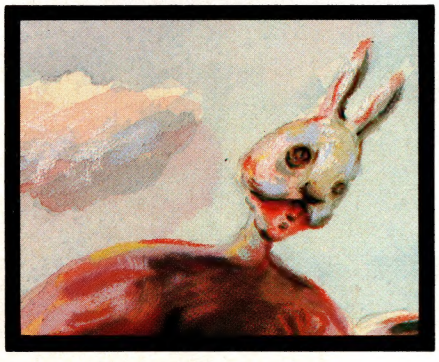
Spend your Sunday with Mike Mudge playing with numbers, lazing around with JJ Clessa, or checking out forthcoming events.

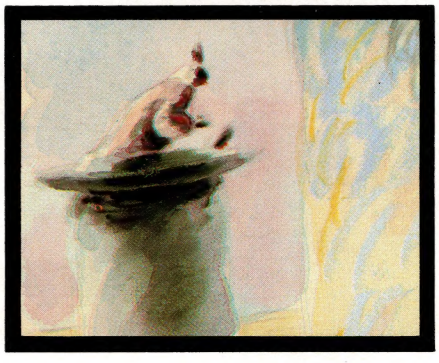
312 MARKETPLACE

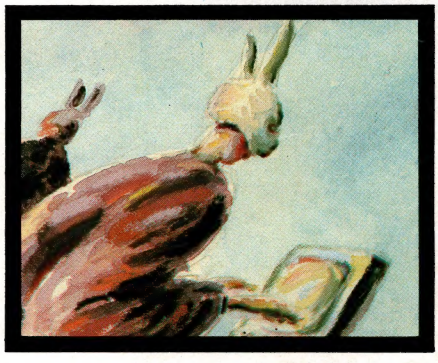
Now in its second month, our customer service directory.

318 ADVERTISERS' INDEX

A list of cluey computer companies.







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FEATURES AND REVIEWS

28 AMSTRAD PC2000 SERIES

After spending up big on advertising to gain a reported 10 per cent market share of PC sales, Amstrad fires another salvo with a range of high-end business PCs. Peter Jackson takes an exclusive look at the machines which range from an enhanced 8086 PC to a fast '386.

49 TURBO PROLOG REVISITED

Alex Lane finds version 2.0 of Turbo Prolog is a cut above the original version with enhanced database and graphics features.

58 LEVERAGING RAM WITH LIM 4.0

Winn Rosch tests seven memory boards that let you take advantage of LIM 4.0's enhanced memory-addressing and support for multi-tasking.

79 LINUS WRITE-TOP

One US company has succeeded in manufacturing a PC that works by handwriting recognition, while all the others are still in the dark. In an exclusive review, Owen Linderholm tests it with his scrawl.

95 ISYS

Phil Cohen takes this Australian text retrieval system for a spin, and finds an impressive quality product with thorough documentation and plenty of grunt.

101 BORLAND BEEFS UP ITS LANGUAGES

Borland has upgraded its premier development languages — Turbo Pascal and Turbo C — with built-in source-level debuggers. Rick Grehan and Tom Thompson find their performance has indeed improved.



111 IZE

How do you index and organise your documents when your hard disk is overflowing with files and folders? Ruth Wallsgrove sets IZE to work, creating some order among her computer-based text.

125 PRESENTATION MANAGER AND LAN MANAGER

Steve Apiki and Stanford Diehl look at Presentation Manager and LAN Manager, two programs which represent a new direction in operating-system design.

135 DESKTOP SOLUTIONS

Putting words and numbers into accessible and meaningful pictures is no mean feat. This month, we present seven graphics programs suitable for the office PC.

- The Advanced Magician
- The Gallery Collection
- GEM Graph Presentation Pack
- GrafTalk
- Harvard Graphics
- Pixie
- 35mm Express

160 POWER SHARING

David Webber describes what makes good or bad hard disks and explains how to choose the correct one for running a network.

170 VOICE RECOGNITION

How do speech recognition systems work? Rupert Goodwins tries to open the pod bay doors verbally with systems from Cherry and IntroVoice, and suggests other applications for hands-free computing.

193 ACCOUNTING

Touche Ross experts help you decide whether you can improve the efficiency of your business by transferring your current manual accounting system onto a computer. This month, we look at single-user packages; next month multi-user packages based on MS-DOS-compatible LANs; and in December, multi-user packages which run on other operating systems.

- Attache
- Chief
- Effective Business Accounting
- Integrated Business Support
- The Officer Cadet
- TAS+ Advanced Accounting
- TCF Bookkeeping System

233 SPEED UP HARD DISKS WITH DCACHE

This issue's productivity utility, DCACHE, speeds throughput by reducing disk access time by as much as 50 per cent. As Douglas Boling reports, it keeps the most recently-used data in its own section of RAM, eliminating the need to access the hard disk when this data is requested.

IDEAS AUST. MICROS01

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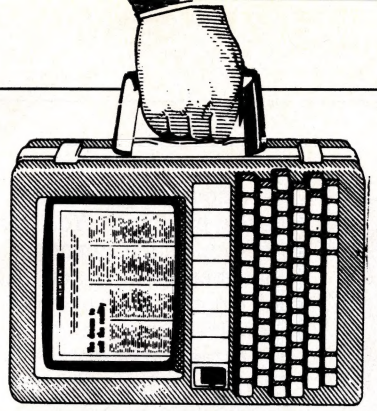
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NEWSPRINT

Guy Kewney and a team of accomplices report on the month's micro news. Details include IBM's re-launch of the AT architecture (though the company won't admit it); memory chips that think; and problems with DOS 4.0.

Sprint finish

Perhaps you read the recent *APC* review of a new, super word processor called Sprint, and were thinking of buying it? Think again.

The review was written by me, and — thank all the gods — I did include in an otherwise favourable article the comment that I didn't really expect it to be ready when its authors, Borland, said it would be. And I was right. I only hope you underlined that sentence in the review. The only question in my mind is whether it ever will be 'ready' in the sense I anticipated.

A parcel calling itself Sprint version 1.00 has arrived here and, on shaking it, all I've managed to obtain from it are worms, followed closely by excuses. Frankly, I wouldn't buy shareware in the state this program has reached. And yet Borland's top executives profess themselves perfectly satisfied with it.

Let me start out by saying that I have already discovered a fatal bug in the release version — a bug which has totally destroyed a document.

Every time the typist hits a key, that keystroke is appended to the swap file; and if the power fails, all those keystrokes are ready to be 'typed' by the computer, to rebuild the document. Due to my own carelessness (I was using the Sprint print preview function, which crashed) I had to reset the machine during an editing session. And, when I restarted, the swap file rebuilt one file with the next file's name, wiping out the next file. And it scrambled the names of all the other open files, too.

Safety, however, is not what Borland makes most fuss about. According to the company, Sprint's claim to fame is that it is familiar. If you are a WordStar user, you can just carry right on using WordStar commands. And the same for a whole list of other popular word-processor software.

Here's how my test of familiarity went. The first thing I tried to do with version 1.00 was write a letter and print it out. So I did; touching nothing, interfering with no parameter settings, adjusting no setups; just switching on, loading Sprint, and typing.

What I saw was almost what I got. It formatted exactly as on the screen but, when printed, it had two lines per page too few. After two pages, the third page started before the top of the paper. So I took up my manual, and it said use the Layout menu to change the paper size.

With ruler and pencil I measured the paper and entered the measurements. Again I printed it. At least, I tried. I selected Papersize, and typed in a width of 8.25 and a length of 11.625. The standard, it said on the menu, was 8.5 by 11.5ins.

'Error: the page margins are bigger than the paper size'. Nothing I could do would make it print at all. So I tried changing the margins.

Sprint lets you change margins in two ways — the layout changes them and the ruler changes them. I changed the ruler first: the new format of the text, across 40 columns, looked fine. It still wouldn't print however. (Actually, it didn't matter what I changed the margins to: the page margins were bigger than the paper size. Even with the left margin 30 characters in and the right margin 10 characters away from the left . . .) The 'layout' margin changes didn't help, either.



The Borland Sprint word processor — what went right?

I abandoned the effort to print within the limits of my paper, and just tried printing. A strange thing: the margins on the screen were where the ruler said they were. I had set the ruler to give a nice, narrow column of 34 characters wide. But printed, they went somewhere else — to 65 characters, the Sprint default.

My first thought was that I was merely being stupid. I decided to switch to WordStar, because the big feature of Sprint is that it can work just like WordStar (or whatever). So, I got an ordinary WordStar document and tried to edit it.

Naturally, I couldn't. It was full of Greek characters.

Not to worry: with Sprint comes a document conversion utility. It can translate any file format to Sprint format by simply commanding it done. 'File Translate Import WordStar' is the command.

'Conversion error 37'. No mention of conversion errors in the manuals. No mention of conversion software, either.

Back to the margins. I tried subtracting ten, adding the two together, adjusting for paper size . . . in the end, I broke down and rang Technical Support. After an afternoon working on it, they rang back and said that I was not going mad; it didn't work.

What am I supposed to tell you? In the review, I made it clear that I'd had trouble formatting Sprint documents, and that Borland had assured me that this would all

be fixed by the time the software was released.

According to Borland, the software is shipping. According to the disk, this is version 1.00. When is it going to be fixed? Why should we believe it can be fixed?

I've been helping Borland test this program since January, and I've complained about this — and other — failings. On most occasions the complaints have been merely received in silence. Once or twice there would be a response, explaining what I had done wrong, or an acknowledgment, saying that the problem "would be fixed in the next release" or "has been fixed." Too many of these have not been fixed.

Some of the explanations I've been given smacked of satire. In the middle of a Monty Python sketch, one wouldn't be surprised to see an urbane John Cleese explain that you can't put a different footer on page three from page five, but you could put a special footer on the last page if you first put a magic phrase at the top of the whole document.

I quote from a letter sent from Technical Support (or QA or Customer Service):
'Here is the @case footer you were having problems with.
@pagefooting@case(page, @ref[lastpage] "end", else "more")) . . .
@tag(lastpage=page) <--- should be last line in document.
I hope this works for you.'

What arcane, unlikely, specialist feature does this achieve? What absurd, sneaky trick did I dream up to trap this program, only to find that the authors were equal to the task?

I'll tell you. I wanted each page of the document to end with the words 'please turn over'. And (believe it or not) I didn't want this on the last page. Instead, I wanted it to say '-end-'.

The manual doesn't talk about magic phrases, naturally enough. It suggests that you just put a new footer in when you want a new footer. That sounds clever enough for me. The program, however, thinks this is silly, and ignores you.

I phoned the product manager in California. "The ruler at the top of the document is the default ruler," he explained. "You can use a command for Ruler-precise settings." I did; nothing happened. "Well print it," he said. Lo: the margins were now what the precise settings said. There was no sign of this on the screen as you typed, of course. Nor was there a visible new ruler.

I complained that this was crazy. "Most people find it pretty intuitive," said the product manager. "It's to help people with strange typesizes."

He may be right, but the manual specifically tells you (first item in the tutorial) to edit the ruler by typing Alt-R, using square brackets to mark the margins.

The product man agreed, but said you shouldn't do it. Yes, the Alt-R command instantly edits the first ruler. But you mustn't let it. "You mustn't edit the first ruler. You have to insert a new one."

Easier said than done, because you can't insert a new ruler before the first paragraph, I pointed out. "No, that's right." So how do you change the first paragraph ruler margins? "You can't."

I confess that I was at a loss for a response. (Actually, you can change the first paragraph. Hold your breath: this is going to hurt. You type your first paragraph. Then you insert a new ruler after the first paragraph. You use the layout menu, option: ruler, then option: insert . . . and bingo — a secondary ruler. Then you go and delete the first paragraph. Then you retype it after the second ruler. Easy.)

What about the paper size?
"What did you type?"
"I typed 11.625 for the length and 8.25 for the width."
"Ah, you didn't type 11.625in?"
"In?"
"Yes, inches."

Nowhere in the manual, the help screens or the tutorial, does it mention that you have to say inches. I guess you have to phone up the product manager in California.

The magic phrase works, by the way. If you have a document with more than one footer, you have to tag each page with @tag(thispage) or @tag(thatpage). And you have to put a statement starting @pagefooting(@case(page, @ref[thispage] @pagefooting(@case(page, @ref[thatpage] at the beginning of the document for every footer. You want a three-line footer? I'm sure it can be done. I leave the details for the alert reader to deduce for themselves as an exercise. (Oh, do remember not to try printing out a document explaining this, by the way: Sprint can't print an '@' symbol unless you type in two of them. Useful for invoices, isn't it? Of course, a company that wasn't a specialist in programming languages might have been tempted to use the double -@ for the programming commands rather than for the @ character. Borland is no such wimpo outfit.)

The conversion utility failure? "We're having that subcontracted, and the error messages are always different, so we can't document them. You probably don't have enough memory . . ." Well, he was right about the memory — you can't use



Compaq has squeezed its Deskpro 386/20 into a more aesthetic and tasteful box — labelled the 386/20e — and added VGA graphics and a high-speed 32k memory cache. At the same time, the company quietly killed off its original Deskpro 386 and the more recent Deskpro 386/20 models.

Now, only the high-end Deskpro 386/25 remains embodied in the original ugly Compaq cabinet, while the newer models are all appearing in the slinky grey small-footprint Deskpro 386s casing. Local Compaq subsidiary CCA Systems is selling the 386/20e Model 1 (without hard disk) for $7990, while the Model 40 (with 40Mbyte hard disk) sells for $10,500 and the Model 110 (with 100Mbyte hard disk) costs $12,950.

Not surprisingly, the 386/20e models feature Compaq's Flex architecture (not to be confused with the forthcoming EISA architecture), and are capable of supporting the new Weitek 3167 numeric coprocessor. Five expansion slots and 1Mbyte of memory are provided as standard.

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SideKick *and* convert documents. And he was right — there's no mention of this in the manual.

On testing the conversion utility with no pop-ups, I found that it worked. The fact that my WordStar document had 34-column margins and the Sprint document had 65-column margins is presumably a trivial detail which any competent 'C' programmer could sort out in a week or so.

My office, full of programmers, has so far been unable to get this print formatting to work on an HP LaserJet II without destroying the printer's ability to work with other text editors.

So: when you want a word processor that can't read WordStar documents, can't adjust margins, can't print on standard computer paper, screws up HP LaserJets and requires you to write a short program in C when you want to change footers, send your money to Borland.

Why is the program like this? Borland's answer is that they can't understand the fuss, everybody finds it intuitive, and that it's a powerful, desktop publishing package, and you have to have different margins on-screen from the margins on paper, because of kerning.

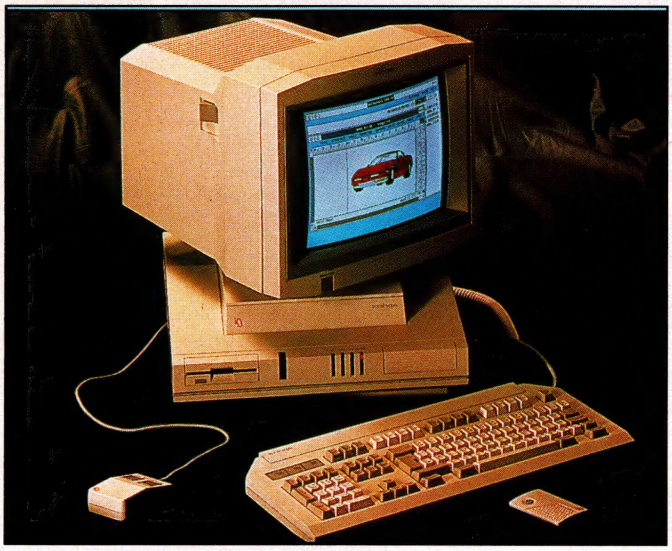
My feeling is that a word processor ought to be able to do the simple things in life simply, and that you should only need to use sophisticated commands when you want sophisticated functions. And I don't see that changing margins, or changing footers, are sophisticated functions.

Apparently, Sprint has 30 per cent of the French word-processing market. I wonder why.

Guy Kewney

Apricot first with MCA clone

Apricot, which bucked the trend to IBM PC compatibility longer than most, has completed its about-face by becoming the first manufacturer to deliver machines using IBM's Micro Channel Architecture (MCA). In addition it has added a number of features, such as on-board Ethernet and security, which it hopes will help its machines score heavily over the opposition in sales to the government, financial and defence marketplaces.



Apricot's Qi: the first IBM PS/2 clone available in Australia

The Qi range (pronounced 'key') comprises three machine types based on 16MHz 80386SX, 20MHz and 25MHz 80386 CPUs. All have four MCA slots (one with the video extension), on-board VGA graphics based around the new Chips & Technologies gate level compatible 451 VGA chip set and the Intel Ethernet chip set. The 80386 machines' MCA expansion includes two 32-bit slots.

Motherboard RAM expansion on the SX is limited and the machine will be shipped in either 1 or 2Mbyte versions. The full '386 machines can take up to 16Mbytes on the motherboard using SIMMS and will be shipped with 1Mbyte installed.

Other standard features include three serial ports — one synchronous and two asynchronous — and security which works below the operating system level directly into the hardware.

Full use of the security, as well as access to the Ethernet, comes only with the purchase of Apricot's $795 (approximately) Qi Environment, an enhanced version of MS-DOS which will also include Microsoft Windows and a telephone manager. An OS/2 version of Qi Environment will also be available. The security of each individual machine is controlled through a small infra-red device which looks like a pregnant credit card. Operating like a remote-control car door lock, users will be able to 'lock' their machine using the card, at which point it will be inaccessible to anyone else and the screen displays a red border to indicate that it is still working, if inaccessible.

At the software level, the user (or system manager on a network) can write-protect or disable each individual hardware component such as disk drive, port or even individual MCA slot. Qi Environment itself is copy-protected by a hardware dongle which sits inside one of two purpose-designed ROM slots.

A full review of the Qi range will appear in a future issue of *APC*. Prices have yet to be set, however some approximate guidelines we were able to glean from Barson Computers, the Australian distributor of Apricot products, are listed in the price guidelines box below.

D Cohen

Courting trouble

While Intel plans to frighten the world with the 80486 next year (first samples by February) it has already had some of the thunder stolen by the announcement of an independently developed '386 clone chip. And, intriguingly, there is a chance that this will appear in an Olivetti machine next year.

The chip comes from Nexgen in Silicon Valley, and, says the young startup company, will be 'fully software compatible with the '386, will run OS/2 and MS-DOS much faster, and will even be faster than the '486'.

That's the good news. The bad news is that run-of-the-

Qi: Price guidelines

386SX	
1.44Mbyte floppy drive only, 1Mbyte RAM	**$7099**
Floppy + 30Mbyte 40ms Miniscribe hard disk, 1Mbyte RAM	**$8525**
Floppy + 47Mbyte 25ms Seagate hard disk, 2Mbyte RAM	**$9699**
386-20	
Floppy + 45Mbyte 25ms Seagate hard disk, 1Mbyte RAM	**$NA**
Floppy + 15Mbyte hard disk, 1Mbyte RAM	**$NA**
386-25	
Floppy + 115Mbyte hard disk	**$NA**



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mill clone builders can't buy the chip. Nexgen, according to *Microprocessor Report,* will sell only system-level workstations or a processor board. And the processor board is not AT bus compatible, and needs a bus converter for Micro Channel.

That means it will be expensive. Estimates in the *Report* suggest that workstations will cost from $12,000 to $200,000.

Olivetti already makes expensive workstations, using AT&T technology (the 3B2 range), so it would be a logical customer — but I'm not just counting on logic. It so happens that Olivetti is one of the companies which owns Nexgen — and *Microprocessor Report* says it is designing the system.

Even more interesting, another shareholder is Chips and Technologies — a company which already provides a set of chips required to build a fast AT clone (the NEAT set) and a Micro Channel bus.

As the Report observed: 'If C&T can produce this chip for Nexgen, surely they can do a design for themselves?'

Wait for the lawsuit.

Guy Kewney

Nightmare in DOS 4.0

Another season, another show, another upgrade to IBM PC-DOS, and at last we have PCs which can handle big hard disks. We also have a 'user-friendly COW' built in.

The COW is Character Orientated Windows.

COW was not written by Microsoft, which wrote Windows and Windows 2 and Windows/386. Instead, it is the first real glimpse of what IBM has in mind for Systems Application Architecture.

Since Microsoft didn't write COW, it is no surprise that Microsoft staff don't think much of it. "Slow, clumsy, and takes 200k," said one. "No graphics, but understands a mouse," said another.

If Systems Application Architecture really means anything, it will be as a series of wires for programs to pull, not a user-friendly shell for managing files. Today, all COW does is load programs for you if you don't like typing commands like DIR or COPY C:\SPREAD\QUATTRO\123.WKS A:TRANSFER.WKS.

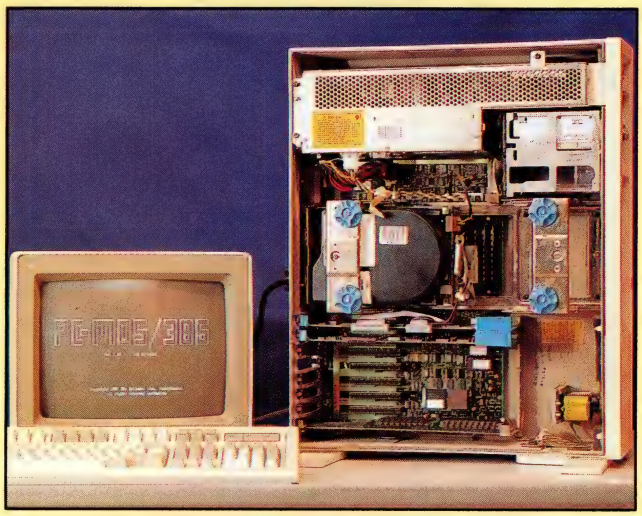
Microsoft is now re-writing DOS 4.0 (IBM wrote it) and will sell it as MS-DOS 4.0 in a couple of months.

For people who are buying brand new 40Mbytes and bigger disks, it will be fine, I'm sure. You'll format, and have one disk drive, no partitions, as big as the drive — up to 500Mbytes. And a single file can fill the whole disk! Until you try to back it up.

But for people who already have a hard disk bigger than 32Mbytes, upgrading from DOS 3.x to DOS 4.0 will, I predict, be a nightmare.

You'll have to back up all the files first. Then you'll reformat the disk under DOS 4.0. Then you'll find that the hard disk you have isn't supported on the list of drive types. Low-level format will work but give you less space than you had before. So, you'll format it back to the system you had on 3.21 and find that 4.0 won't work. I hope I'm wrong.

Guy Kewney



For those PC users who remain unimpressed by OS/2, the latest version of The Software Link's multi-user, multi-tasking operating system, PC-MOS 2.20 provides an ever more appealing alternative. The new release extends its support for networks and other hardware and software. Like OS/2, the operating system is designed to run on an 80286 or 80386-based PC, although the product is superior in that it supports up to 24 dumb terminals.

PC-MOS prices are $446 for the single-user version, $1267 for a five-user version and $2088 for a package supporting 25 users, according to the Australian supplier, SPS. For the first time, the new release of PC-MOS supports Novell's NetWare, enabling PC-MOS terminal users to participate as though they have PCs on a Novell network. The designers accomplished this with help from Novell, explained Ms O'Hanlon, a spokeswoman for The Software Link.

"A traditional Novell network required a dedicated PC at each node," she said. "Now Novell has developed a NetWare interface for PC-MOS that lets it talk to dedicated terminals running the new version of PC-MOS." In addition, when running on an 80386-based PC, the new release supports up to 16 modems and will recognise each as a separate workstation.

Lotus 1-2-3 enhancement

While the world waits for 1-2-3 Release 3, many enterprising companies are producing add-ins to the existing version to provide some of the more notable features promised for Release 3. One much needed enchancement is now available, in the US at least, from a firm called Goldata. @WSLINK (pronounced 'Worksheet Links') has a Lotus 1-2-3 and Symphony utility that lets you link an unlimited number of worksheets. The program also lets you link data in worksheets on disk to worksheets in memory.

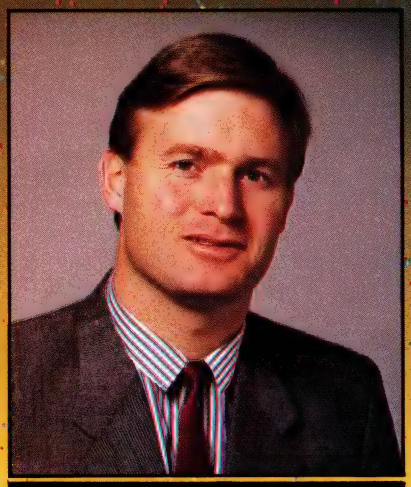
The program is network-compatible; when someone else has saved changes on dependent worksheets, it updates the values in the current worksheet on the next recalculation. Because the program reads 1-2-3 and Symphony file formats, you can link their worksheets interchangeably.

The program runs on the IBM PC, XT, AT, PS/2s, and compatibles with 19k of RAM, DOS 2.0 or higher, and Lotus 1-2-3 version 2.0 or higher or any version of Symphony. It's priced at $US49.95 and is available from Goldata Computer Services, 2 Bryn Mawr Avenue, Bryn Mawr, Pennsylvania 19010. Tel: (215) 525 1036.

Share graphics via phone

Draw2Me is a shareware program from the US that lets two people draw the same picture simultaneously over standard telephone lines. Drawing commands are sent immediately, so you can see editing changes without having to wait for time-consuming screen dumps. You can also create a drawing off-line and send it to the remote site for editing.

The program's Chat Win-



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dow feature lets both users type on the keyboard to 'talk' to each other while online. This makes a simultaneous voice connection unnecessary.

Draw2Me works on the IBM PC, ATs, PS/2s, etc with a Hayes-compatible modem, 320k of RAM, and a mouse. The program is compatible with EGA, VGA, CGA, and Microsoft Windows and can support 9600-bits-per-second transfers. We don't know of any Australian outlet, so you'll have to order it direct from the States. It sells for $US89.95. Contact DLS Development, One Gale Road, Brick, New Jersey 08723. Tel: (201) 920 6807.

Language lets anyone do Windows

Developers at Carnegie-Mellon University in the US say they've got a computer language that will let nonprofessional programmers write programs that use those hot graphics-oriented features characteristic of today's operating systems, such as windows, pull-down menus, and multi-font text. The language is cT, short for CMU Tutor. Tutor was originally part of the PLATO educational system but according to one of the developers, Bruce Sherwood, this new language goes far beyond the original.

The language is "really designed for any kind of computer programming, including research computing. It's a general-purpose language for any situation where you're going to have a modern user interface," Sherwood said. It's also highly machine-independent, he said, because cT implementations are designed for font and graphics rescaling; the same cT source code will run on a Mac, a Sun, an IBM RT PC, and a microVAX — and on most of those machines, Sherwood said, cT is the only language that lets ordinary people program using graphics and multi-font text.

"One way of describing Tutor languages is to say that their goals and methods are reminiscent of a very good Basic," Sherwood said, but cT begins "from the expectation that you're writing a program for somebody else to use." For example, Tutor's input statement lets the program not only get input from the user, but also makes sure it's the right kind of output. "The programmer doesn't have to do all the analysis to make the validity checks. You're encouraged to look," Sherwood said.

"There are five things any language has to do. Calculate, display, sequence, analyse input, and read and write files. Where cT is strong is display, sequence, and analysis."

A cT program consists of a set of root-level procedures called 'units'; these can accept parameters by value or address and return a result. Units are linked with the commands next and previous: a user can pull down a menu and click on previous and review the previous unit. "With Tutor-class languages, a program is really a whole archipelago of these unit islands, and there are some interesting structures between the islands," Sherwood said.

Source and execution windows are both active; because fonts and graphics can be scaled, you can see a miniature version of your execution window if you like. A programmer can select a source-code co-ordinate by clicking the mouse at a point in the execution window. There's also an online reference manual, complete with working examples that you can cut and paste into the source window and execute. "It's a fabulous situa-

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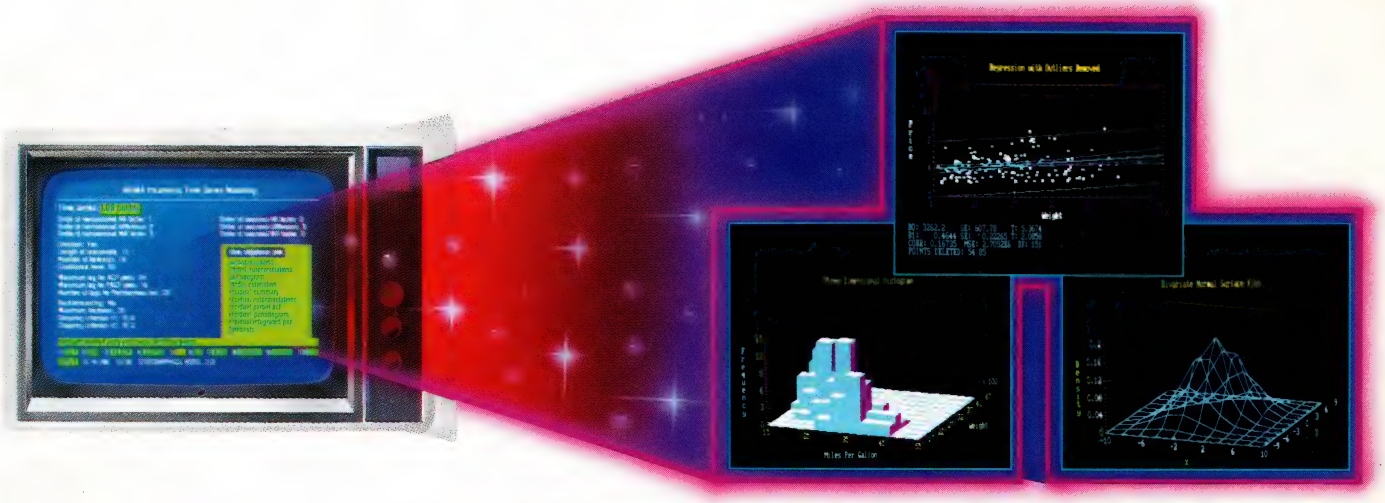
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tion for programming by example," Sherwood said.

At Carnegie-Mellon, cT has been in use for a year, but it's only now becoming commercially available. The Macintosh version, which runs on the Mac Plus, the Mac SE, or the Mac II, is $US92.50 from cT Distribution, Center for the Design of Educational Computing, Carnegie-Mellon University, Pittsburgh, PA 15213. Tel: (412) 268 5638. An IBM PS/2 version will follow shortly, and a Unix version (running under XWindows) should be available later this year.

TI mixes GaAs and Silicon

In the chip-making business, silicon and gallium arsenide (GaAs) are like water and oil — they just don't mix. The standard ways to make chips from each substance are almost completely incompatible; silicon chips use TTL-level inputs and outputs, for example, while GaAs typically runs at microwave frequencies. It's only recently that one company, Gazelle, has created a GaAs chip that can be used in conjunction with conventional silicon chips.

But Texas Instruments researchers have now demonstrated the first ICs that contain both silicon and GaAs transistors on the same piece of silicon. According to Hisashi Shichijo, who developed the new process along with Richard Matyi, "this means we can take advantage of the merits of gallium arsenide and silicon on the same chip."

Shichijo said the new process is significantly more complicated than the Gazelle approach, which will allow designers to mix GaAs and silicon chips on the same circuit board. The new TI process mixes the materials on the same chip. "A chip designer traditionally has to choose between the two," Shichijo said. "Gallium arsenide is faster, but it has problems — it's small, it's fragile, it breaks, it has defects — so it's not possible to build large-scale circuits. What we've done is to deposit localised gallium arsenide films on a silicon substrate, so you can add GaAs devices or circuits to silicon circuits."

This makes large-scale GaAs circuits practical, but because the silicon and GaAs circuits can be mixed on a chip, large-scale GaAs won't usually be necessary, Shichijo said. "You can put the GaAs where you'd really like to have speed, and use silicon for the rest of it." For example, silicon memory could incorporate GaAs control logic for better response time; a dense silicon microprocessor might have an integrated GaAs register file or cache.

In developing the GaAs-on-Silicon epitaxial growth technique, the TI researchers aimed to develop a process that could be applied directly to high-volume production. According to Richard Matyi, "Because silicon processing is extremely sensitive to the presence of impurities — and GaAs essentially represents an impurity — we completed silicon processing before we added the GaAs. And although it would have been simpler to grow the GaAs atop the silicon in layers two to three micro-metres thick, we decided to embed the GaAs islands in the wafer to produce a coplanar surface. Devices with such flat surfaces are easier and more cost-effective to manufacture in high volume, and they're more reliable."

Shichijo said GaAs optical devices, such as lasers, could be included on silicon chips to speed up chip-to-chip communication by a fac-

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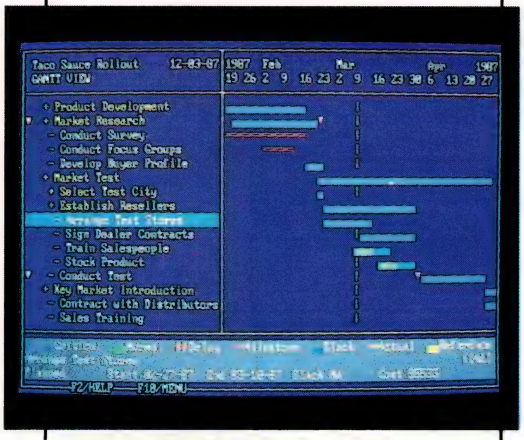
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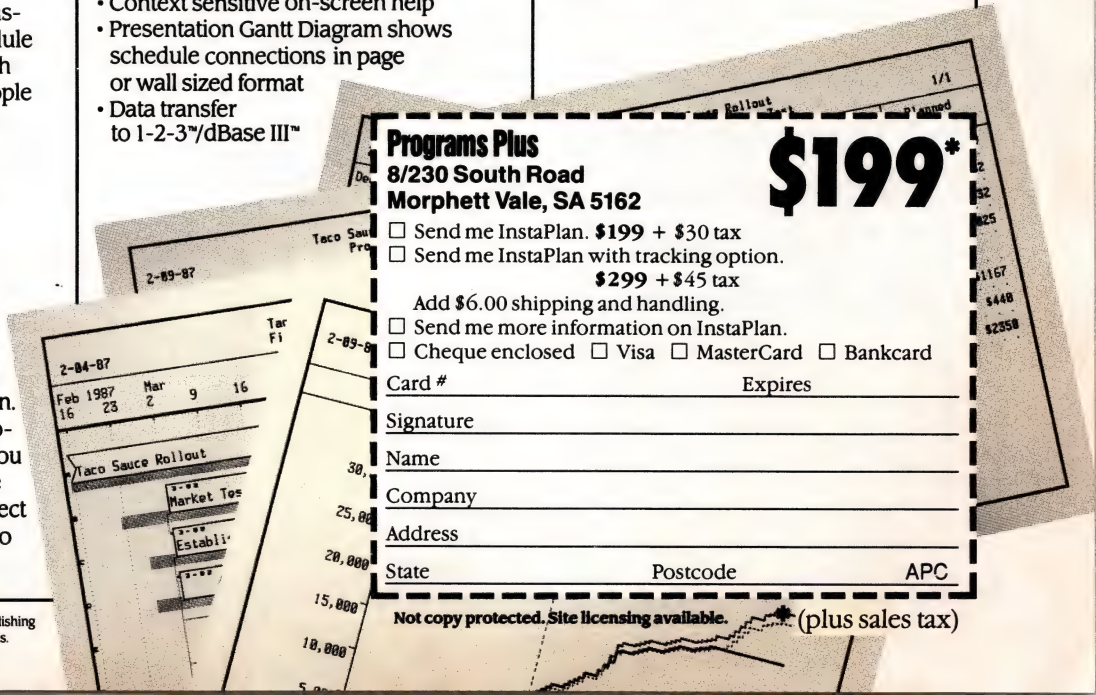
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tor of 10. To demonstrate the new chip, the researchers produced several ring oscillators that mixed silicon CMOS and GaAs metal semiconductor field-effect transistor circuits.

But some designers say GaAs has a long way to go before it's a commercially viable component of desktop computers. They think it will be a long time before chip makers can produce GaAS on silicon substrates at good yields, and they may never overcome problems inherent in GaAs circuitry.

Memory chips with brains

After hitting too many snags and dumping a project to build a massively parallel matrix-multiplication analog chip for pattern-recognition applications, Oxford Computer founder Steven Morton hit upon the idea of what he calls 'intelligent memory chips'. With Morton's design, adding memory also adds processing power. The chips, which are strung together in a module that fits in the palm of one hand, do more than serve as memory devices; they also take care of some of the processing chores, which gets around the slowdown caused by moving bits back and forth between memory and the central processor.

In an interview at the International Conference on Neural Networks, Morton said that standard memory is inefficient for matrix-intensive applications, such as three-dimensional graphics and pattern recognition, because data must be moved out of memory to a separate processor for computations and then returned to memory for output of the results. Intelligent memory chips have the capacity to perform "intense computations and work cooperatively," he said. The capability to perform on-board matrix manipulation also distinguishes the chips from so-called smart memories, such as video dynamic RAMs, that include on-board shift registers.

Morton points out that his chips are not suited for applications that don't require intense matrix manipulation — so don't plan to replace your conventional memory chips and expect a blazing performance increase with your word processor. And he's currently looking for financial support to manufacture the chips and expects availability in the third quarter of 1989.

The chips can be configured in 'intelligent memory modules' that contain from 64k to 1Mbyte of storage to provide 1.28 billion 8-bit multiplications and additions per second for image processing; 40 million 32-bit multiplications and additions per second for 2-D fast Fourier transforms and real-time 3-D graphics; or 80 million floating-point operations per second.

Each chip provides its part of the matrix solution; the partial results are then accumulated to come up with a final solution. A control chip manages the partial results and provides an interface to the host bus. All this occurs without transporting blocks of data in and out of memory, tying up the bus, or slowing down the central processor. Morton envisages a graphics board with his special chips that plugs into a system's bus.

Morton claims that his approach skirts the Von Neumann bottleneck encountered when intense computational activity can clog the data bus and overload the processor. "With memory actually manipulating the matrix information, the central processor can go off and do other things," he said.

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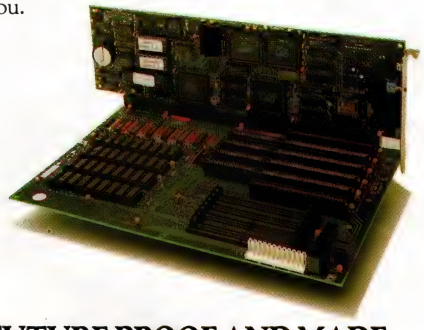
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'3-D Computer' stacks processors

The prototype for a 3-D integrated circuit that packs 1024 processors into a single chip has been developed by scientists at Hughes Research Laboratories in California. The so-called 3-D computer is the first step in developing an ultra-fast machine that squeezes supercomputer power into a processor about the size of a tuna can.

"The 3-D computer is an array processor, architecturally and behaviorally," Hughes staff scientist Mike Little said. "That means it has a certain range of applications — for example, image processing, radar signal processing, weather modelling, and finite-element analysis."

The chip consists of a set of stacked silicon wafers. Each wafer contains an array of 32 by 32 processor segments, each of which is connected to its four neighbours on the wafer as well as to the other wafers in the stack. "We've developed two technologies," Little said. "One involves connections through a wafer; the other involves the connections from wafer to wafer. The new technology allows us to re-think how to partition circuits."

To make a connection from one wafer to another, Little's team uses a 'micro-bridge': an inverted U on top of one wafer and on the bottom of another. "When you stack the wafers, the pair of U's intersect and form the connection between the two wafers," Little said. To make connections through a wafer, the Hughes scientists use an innovative form of thermal migration to create 10,000 channels at a time in each wafer.

To make the 3-D computer, Little explained, "First we put the channels in, then we add the circuits — conventional circuit fabrication from a commercial foundry." Instead of putting a complete processor on each wafer, only one section of the processor appears on each wafer; when the wafers are stacked, each column forms a complete processor. As a result, "the complexity of the processor is how deep it is, not its lateral extent," Little said; a more complex processor could be constructed by stacking more wafers on top of those already there.

The current 3-D computer contains 1024 processors in a 32 by 32-processor array; it's a fixed-point, 16-bit computer in a chunk of silicon 3ins square and a half an inch high.

Multiple programs on your Atari ST

You can have more than one program in your Atari ST at one time with Twist, a switcher program from Hi-Soft. It lets you treat whole programs as if they were a desk accessory, sharing the machine with another program.

Twist works with most Atari ST applications and with GEM programs. It understands programs running with different screen resolutions — up to 14 programs at once, memory permitting. A shared RAM disk is included. You can invoke Twist by pressing a key or through the Twist control program.

Ashton-Tate clones the dBASE cloners

The thought of all those dBASE users buying third-party source code compilers from companies such as Nantucket and Fox Software has finally had an effect on Ashton-Tate. After years of in-

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dustry pressure, the company has at last announced its very own 'official' compiler, along with a translation utility to help those who have 'strayed' return to the fold.

But after years of inactivity, Ashton-Tate's latest strategic campaign to recapture the loyalty of dBASE users and encourage them to upgrade to dBASE IV may face credibility problems.

Not surprisingly, both products are being designed for Ashton-Tate under contract by small US software developers, like so many other products which now bear the Ashton-Tate logo.

The new compiler, which addresses users' long-standing demand for an alternative to dBASE III Plus's run-time facility, produces faster applications that execute independently of dBASE IV, sources claim. The translation facility is intended to make it easy for users who have adopted dBASE work-alikes to move back to dBASE IV without rewriting their applications.

Ashton-Tate has reportedly lined up Apex Software, a US dBASE development house, to build an executable compiler for dBASE IV. The compiler expands on several extensions pioneered by Clipper, including the concept of user-defined functions. Ashton-Tate's offering will allow dBASE IV users not only to add functions to the language, but to create their own commands and customise dBASE syntax.

Like Clipper, the new compiler, which will be available early next year, allows users to link C or assembly-language routines into their compiled dBASE programs.

The translation utility converts applications written in FoxBase, Clipper or WordTech's Quicksilver into dBASE IV format without requiring programmers to rewrite any code.

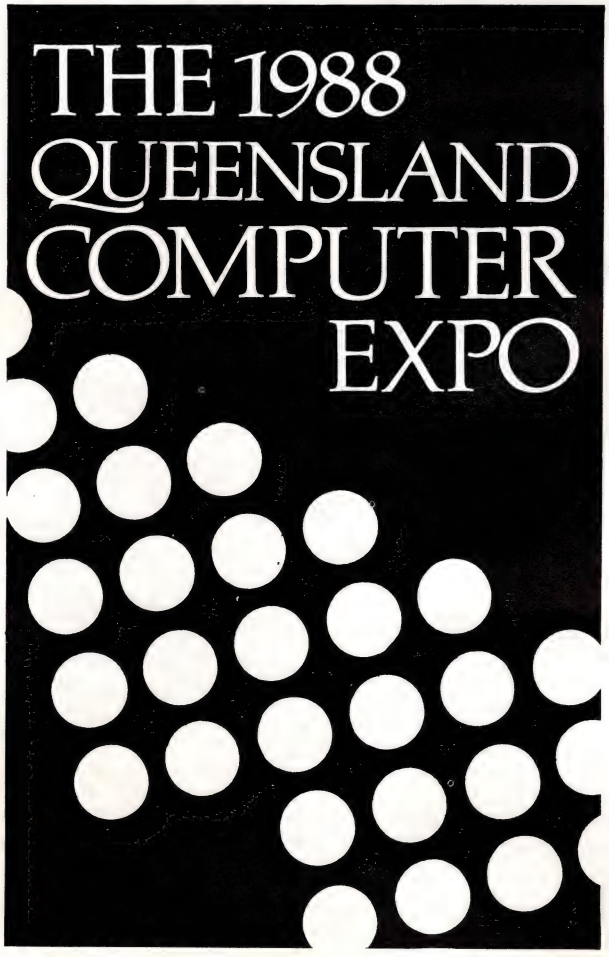
Micro Channel rivals propose alternative bus

In a belated response to IBM's Micro Channel architecture, a consortium of major PC manufacturers has come up with its own specification for a 32-bit bus that includes many Micro Channel features, while retaining downward compatibility with 16-bit, AT-standard add-in cards.

The so-called Enhanced Industry Standard Architecture (EISA) specification is compatible with AT-bus systems, but also allows 80386-based machines to take advantage of such features as support for more than 16Mbytes of memory and data-transfer rates as high as 33Mbytes per second, according to Rod Canion, president of Compaq. IBM's Micro Channel 'burst transfer' mode operates at 18.7Mbytes per second. Participating companies are not expected to demonstrate new products or computers featuring the 32-bit bus specification for another year. But since the EISA specification is in the public domain, no licensing fees are payable, making it easier for smaller manufacturers to move into the 32-bit market.

"We'll be looking at the technology and doing something with it," said Peter Nunn, managing director of Terran Computers, a Melbourne PC designer and manufacturer. "It makes a great deal of sense if most of the industry gets behind this standard. Even if it is only as an upgrade path, then I think it is a winner. "It is probably good to have two competing bus standards, as it offers users a choice," he concluded.

The EISA specification outlines improved transfer rates of very high-performance I/O



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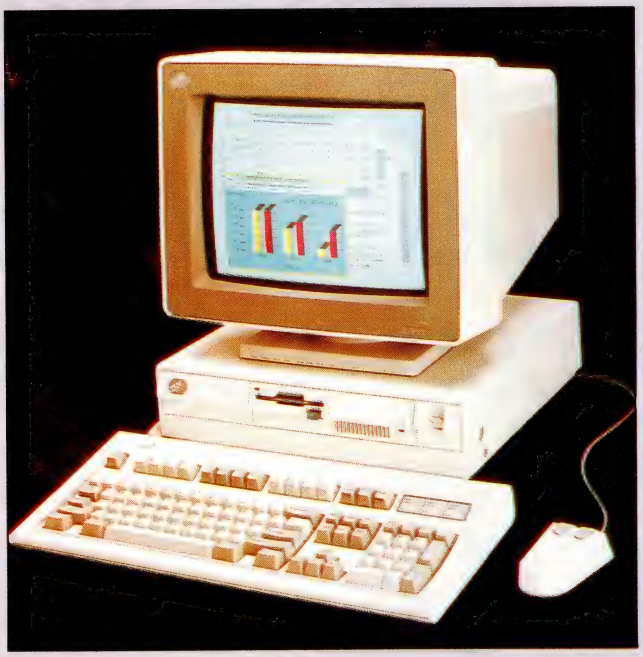
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After steadfastly assuring the industry that it would absolutely, positively, definitely never ever regress to the old AT-style architecture, IBM on September 16 announced two new additions to its PS/2 range — based on none other than the good old AT bus.

The new PS/2 Model 30 286 E01 and Model 30 286 E21 are based around a 10MHz version of Intel's 80286 CPU running with a single wait state, and will be fitted with 1Mbyte of memory, expandable to 4Mbytes on the motherboard. The base model E01 configuration includes a single 1.4Mbyte 3.5in floppy-disk drive (as opposed to the 720k 3.5in drive in the older 8086-based Model 30), while the more powerful E21 version includes a 20Mbyte hard disk.

The new Model 30 286 bus design is simpler than the original PC AT architecture, but still supports industry-standard 16-bit AT cards. It is based on a five-piece AT chip set from VLSI Technologies that is claimed to reduce the number of additional devices required to build an AT compatible by 83 per cent.

It is not clear if or when the new 80286-based units will replace the less powerful 8086-based Model 30 units, but ever since the PCjr debacle it has been IBM's practice to let superseded systems quietly fade away, rather than announce their demise.

peripherals such as network and graphics- controller cards. Existing AT-bus boards are compatible with the specification; however, to take advantage of the advanced features, vendors must develop new boards.

A key feature of the EISA specification is its ability to address the full 4Gbyte physical memory capacity of 80386-based computers. Currently, AT computers are limited to a meagre 16Mbytes of memory.

Vendors endorsing EISA in addition to Compaq, Phoenix Technologies, Tecmar and Everex include AST Research, Wyse Technology, Olivetti, Hewlett-Packard, NEC, Epson, Tandy and Zenith Data Systems. Other vendors that have agreed to provide technology to the group include Chips & Technologies, Intel and Microsoft.

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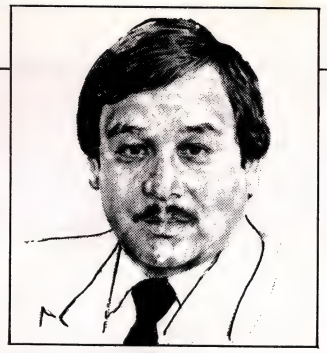
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STATESIDE

The recent MacWorld exhibition in the US yielded some interesting innovations based on what turned out to be the two main themes of the show — HyperCard and graphics. Our man in America, Tim Bajarin, describes the ones to watch.

Twice a year I dedicate myself to writing about the Macintosh as a result of covering the bi-annual MacWorld exhibition.

This trade and user show started in January 1985, a year after the Mac was born, and began as a real gamble for the show co-ordinators as the future of the machine was in question in those days.

But, as the Mac has gained in popularity and the whole world has started to discover what a powerful and unique computer it really is, the show has grown and become one of the largest computer shows in the US. This year's Boston affair had over 300 exhibitors and was so large that it filled two separate convention sites.

Although Apple did not use the show to introduce any new hardware, as it has done in the past, the various vendors gave the show its excitement with some fascinating new products of their own.

The theme of the show in general can be summed up in two words: HyperCard and graphics. This show marked the one year anniversary of HyperCard and its impact was evident throughout. From John Sculley's opening address to the 10 sessions that dealt with various aspects of HyperCard and its future, it is clear that this program is an important part of the Mac's long-term future.

The other area that was clearly important was the Macintosh's ability to deliver serious applications in the world of graphics presentations and multi-media computing. In fact, folks who hang around Apple these days say that multi-media computing — or the various technologies like animation, CDI and video which are a critical part of this developing concept — are the key areas that make Apple management drool.

They also say that many of these technologies are being tied directly to work on the new O/S, as well as hardware products in the pipeline, and you can expect to see Apple make the 1990s the decade where graphically animated data delivery becomes the standard way to get information on the Mac.

A key example of how both HyperCard and multi-media computing go hand in hand with graphical data delivery comes from a firm called the Voyager Company. With a videodisc player, it uses HyperCard as the data searching engine to go out to the disc and get the information, and then ties it to sound as well as video.

One of the Voyager Company's products is a videodisc catalogue of 6000 works of art from the Louvre in Paris, with over 35,000 images and including video commentary on 75 selected works. It comes in three volumes which deal with paintings and drawings, sculpture and *objets d'art,* and antiquities. Each disc will cost $US99 and be available this year.

Also in the company's library will be a similar set of videodiscs that include all the paintings from the National Gallery Of Art in Washington, DC. This will also be available by the end of the year.

The Voyager Company already has various videodisc movies in its library, as well as science topics for the education market.

The Voyager Company is at 2139 Manning Avenue, Los Angeles, California 90025, USA, tel: (213) 474 0032.

Another key product introduced at the show is called HyperAnimator. Published by BrightStar Technology of 14450 NE 29th PL, Suite 220 Bellvue, WA 98007, USA, tel: (206) 885 5446, this is a package that, when linked to HyperCard stacks, allows you to create animated objects quickly and easily and can be used to deliver all sorts of information.

One of BrightStar's demos shows how you can go out to a graphics palette and click on various parts of a face, bring them together to create your character, and, using a spec sheet approach, give it animated attributes.

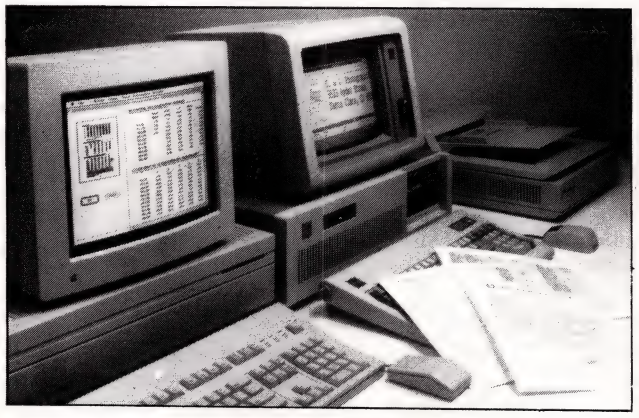
Within minutes a user can have his 'character' — or what John Sculley calls his 'agent' — telling you the time, saying hello or delivering a message. If you tied HyperAnimator to a HyperCard communications program, it could even be used as a voice mail delivery system.

This program has tremendous potential because it is so simple to use.

The concept is not new to the Mac, however. VideoWorks from Macromind has been a leader in this field for some time, but VideoWorks is difficult to use and is targetted more towards the



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Making music on the Mac with Finale

power user. But, with HyperAnimator, even a child could create an animated character and make it sing, dance or tell jokes in minutes.

Speaking of VideoWorks, VideoWorks Professional made its debut at MacWorld. This product will have a real impact on graphics presentations and animated creation.

With the arrival of 24-bit and 32-bit colour monitors, and the power of the Mac II set to reach new heights, the Mac is certain to be used increasingly in professional graphics environments for on-screen animation and video presentations.

Another big item at MacWorld was the public debut of Aldus' Persuasion and Letraset's Standout, two new products for desktop presentations. Both products take the concept of desktop presentation to greater heights and will provide More and PowerPoint with a hard act to follow in their next implementations.

John Sculley has said that he believes desktop presentation is a larger market than desktop publishing, and when you bring animation, CDI and video into this concept of presentation, you see a grass-roots idea permeating every aspect of personal computer development.

One other graphics note of interest. The leading paint package on the Amiga is MicroIllusions' Photon Paint. This powerful hold-and-modify paint program will soon be on the Mac, and will be followed by a Mac version of Cell Animator and Transport Controller, a piece of software that is a missing link between graphics and animation programs and a VCR.

There is tremendous irony in this move by MicroIllusions to the Mac, as the Amiga has been the leader in what Apple is just now discovering as 'multi-media computing'. Although the company has not yet given up hope for its Amiga products and Commodore's chances at making the Amiga a serious competitor in the US, it is in the forefront of this technology — and riding Apple's coat-tails at this time spells big money if things are done right.

Not all of the MacWorld excitement was tied just to HyperCard and graphics, though. Another new product introduced at the show was OmniPage from Caere Corporation, at 100 Cooper Court, Los Gatos, California 95030, USA, tel: (408) 395 7000. This OCR software application lets desktop scanners recognise virtually any page, no matter what mix of images and different sizes and fonts of type the page contains.

Prior to OmniPage, desktop scanners could only recognise characters on very tightly defined sets of documents. In contrast, OmniPage lets scanners recognise a variety of pages with a mixture of images and text. The program automatically differentiates between images and text in a single pass, yet stores them in TIFF or ASCII.

Although OmniPage was introduced at the show with Apple's new scanner, it works with IBM PC-based scanners, too. Called 'page recognition software', it is the best OCR scanning software I have seen — and one that will make the scanner a serious tool in the office.

Both products will be available by the time you read this, with the Mac version selling for $US175 and the PC version for $US1995.

One other product of note comes from Coda Music Software, at 1401 East 79th Street, Bloomington, MN 55424, USA, tel: (612) 854 12288, and which has to be seen to be believed.

I am not a musician, but my feeble attempt to learn the accordion when I was 10 years old at least gave me a basic appreciation for this product. Entitled Finale, this piece of Mac software is a musical composer's best friend. It is defined as the first music transcription software that allows amateur or advanced composers to easily and accurately transcribe musical notation from ideas to paper using MIDI equipment, pointing devices or computer keyboards. Watching it work with a MIDI guitar or MIDI clarinet gives you a real understanding of how it works.

Finale features built-in transcription and notation intelligence, eliminating a substantial number of edit-display cycles. Its strongest asset is an ability to print music entered from a MIDI keyboard. Users simply play the keyboard, even in rubato-style tempos, and Finale prints the music using a proprietary 'time-tagging' method.

Its easy-to-use Mac interface and menu system allows you to pull down whole bars of notes and integrate them into other areas of the score. And it can automatically create multiple orchestral parts for various instruments. Another amazing feature is its ability to take these full orchestrations and isolate, for example, the piano score, also automatically. So, any person who plays music can quickly see the notes they have played on the screen and print out the score immediately.

Finale could have a real impact on the entertainment industry, where most musical scores are still written by hand. And, it could make serious composers out of talented young musicians who can read music but have never attempted to write it.

Available in October, it will retail for around $US800.

The next MacWorld show will be held in San Francisco in January 1989. At this show, Apple is expected to introduce a whole range of new products, including its 68030-based Mac 3 and the long-awaited laptop.

Insiders say that Apple will introduce two versions of this laptop, using the 68000 and 68020 chips, and will use a lot of ROM-based software as well as a credit card-style Smartcard for storage and software loading.

You can also expect Apple to reveal more of its multimedia concepts for computing at this time, with special emphasis on education and strong hints of how the company will use animation and video in the area of business applications in the very near future.

Apple may hold Australian press conferences in which company representatives will show one of three films — Knowledge Navigator, HyperCard 1992 or Gray Flannel Navigator. If you're invited, do go. These films will give a real view of how Apple sees the future of computing, and how it plans to be the company that continues to lead the industry in computer innovation.

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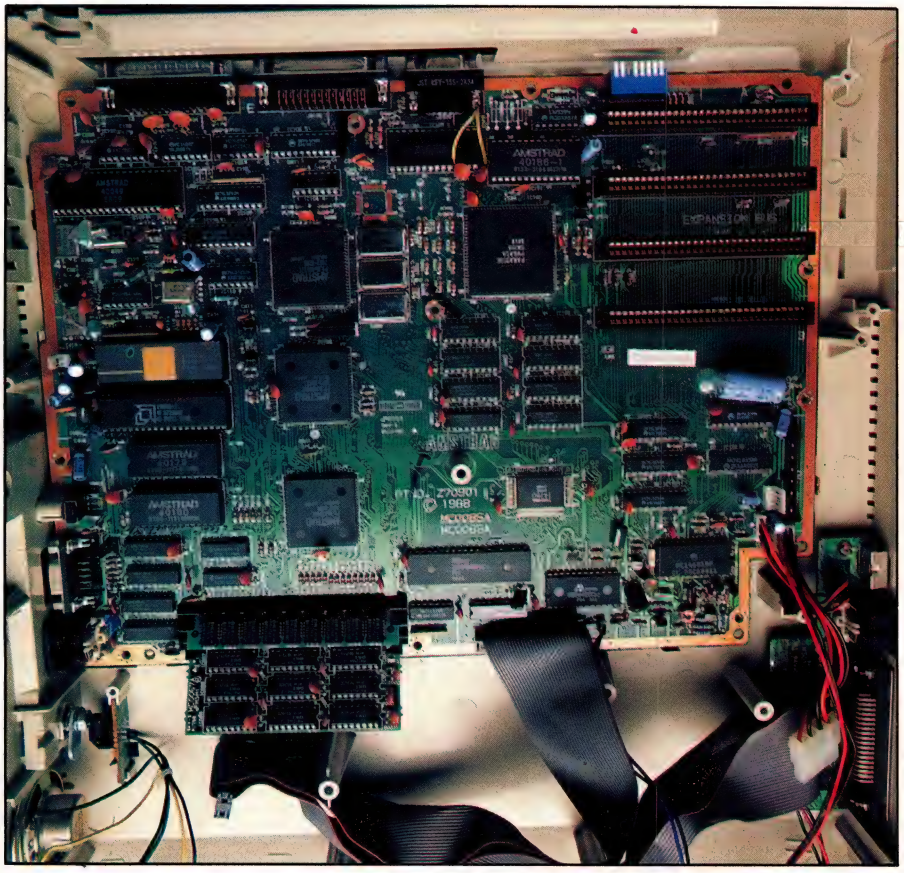
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APC1

Amstrad PC2000 series

Amstrad's cheap-and-cheerful-but-reliable reputation has lent some significance to any new launch from the company, but the PC2000 range, due for launch in December, goes against expectations with its refinements and improvement on the 8086 system aimed at the business PC user. Peter Jackson witnesses the company's transition from corner shop to corporate market.





Getting inside the PC2086 is no simple task as there are plenty of screws, clips and wires to remove. Note the number of Amstrad custom chips

It's not so long since the significance to the computer industry of a new Amstrad launch lay only in whether the new hi-fi had back-to-back cassette copying. But times have changed: with the success of the PCW and PC1000 ranges in their respective low-end markets, the release of the Amstrad PC2000 range is a major event.

But it is not the type of event that most commentators have been predicting. There is no bargain-basement 32-bit PC, no cut-down 80386SX machine, and no cheap-as-you-can-get AT clone. Instead, Amstrad has refined its 8086 system with improved and up-to-date peripherals, and has entered the expected 80286 and 80386 systems into the mainstream of the business PC market at prices to match. And driving home Amstrad's aspiration to become a major system supplier, there is a new line of analogue VGA monitors that can be used with anyone else's machines as well as Amstrad's own.

The company has decided that if it is going to expand its market with higher-performance machines, it is going to do it thoroughly. Only newly-appointed Amstrad Advanced System Centres, being recruited from dealers who may already be selling IBM, Compaq or Olivetti systems, will be allowed to sell the two more powerful new machines. And to make a further impact in this market, no corners have been cut in performance to



The full line up of machines with all three colour monitors. From left to right: PC2086, 2286 and 2386. Monitors: 14in and 12in high definition, 14in standard definition

get down to a price — the PC2386, for example, is a 20MHz machine with 4Mbytes of RAM as standard and is right up there with the fastest 80386 systems around.

Amstrad's planned metamorphosis from a low-end compatible maker into a high-end leading edge systems supplier will be a neat trick if the company can pull it off. It certainly has the will and the market presence. Does the PC2000 range provide the machines?

PC2086

At first reading, and even at second and third, the PC2086 specifications make it seem like a PS/2 Model 30-compatible built on the solid foundations of the PC1640.

Visually, though, the PC2086 looks more like an over-inflated Apricot Xen, complete with the low-profile front panel and the raised bulge at the back to hold the expansion boards. The case is much bulkier than that of the PC1640 for at least one good reason: the mains power supply is now built into the system unit rather than the monitor, making the PC2086 a more conventional machine than its predecessors.

The front panel is large enough to take two half-height 5.25in floppy disk drives, but Amstrad has instead gone for third-height 3.5in devices, two of which can be fitted. There is a choice of systems with one or two 720k floppy drives, or with one 720k drive and a 30Mbyte hard disk. The use of 3.5in floppy drives fits in with Amstrad's strategy for the machine, which is to produce an 8086-based system that anyone can buy, but which includes all the innovations that have become widespread since the launch of the original PC1640 two years ago.

However, Amstrad is also trying to

Amstrad's new monitors

Amstrad's new monitor range comprises four VGA-compatible analogue-only screens, covering a range of sizes and screen resolutions. The 12in monochrome display is automatically sensed by the system, and can display 256 grey scales. The smallest colour screen is the 12in model, which has a dot pitch — the distance between the colour phosphor dots that produce the picture — of 0.28mm and is described as 'high resolution'.

This contrasts with the cheaper 14in colour screen, which has a cruder dot pitch of 0.42mm and a consequent fussier display. The top-end monitor is the 14in high-resolution model, with a 0.29mm dot pitch. For comparison, most VGA-compatible monitors have a 0.31mm dot pitch, while the highest-quality Sony screens have a pitch of 0.26mm.

All four monitors come with a 15-pin analogue plug and an integral mains cable, with contrast and brightness controls, and other controls for horizontal and vertical sizing. They will be sold separately for users of other machines, but Amstrad obviously believes that they will be the standard fittings on the PC2000 range for all those who do not have a multi-sync handy. There is even a sticker on the machines' system units saying 'For best results use Amstrad monitors', which is a harmless piece of self-promotion.

The monitors are not the best VGA screens around, buy they are not the worst either.

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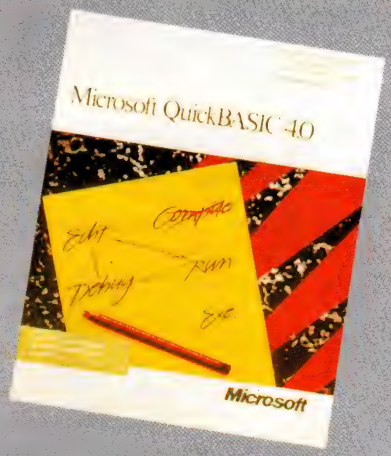
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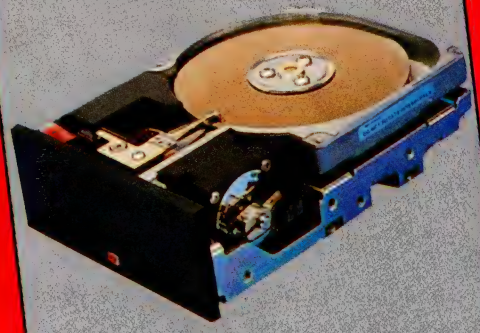
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avoid the problems that IBM PS/2 customers have had in managing the switch from 5.25in floppies to 3.5in, and has included a dedicated floppy disk socket on the right-hand side of the box. This socket, common throughout the range, can handle 360k or 1.2Mbyte 5.25in drives and 720k 3.5in drives, and these need only be bare drives with a case around them and suitable cables. Amstrad has thoughtfully provided a DIN power take-off socket next to the floppy interface port and an adaptor cable from this can plug directly into any drive's standard power input. Installing such a drive is a DIY job, and there will probably be a market for bare drives with some cobbled-together but exorbitantly-priced adaptor cables.

The system can be configured to boot from this external drive if required, and the default A: and B: floppy designations can be switched around so that existing copy-protected software on 5.25in disks — Lotus 1-2-3 being the prime example — can be run with their key disks in the A: drive as required.

The left-hand side of the case holds the mouse and keyboard sockets, a volume control knob and — another new addition — a keyboard lock like those found on ATs and their clones.

Again, this feature appears throughout the range. On the back panel are a conventional set of input and output ports — one serial, one bi-directional parallel and one to drive the monitor — and a video configuration DIP switch panel.

A clip-on panel gives access to the connectors of any expansion boards plugged into the three full-length PC-compatible expansion slots, and like the older PCs a panel at the top rear of the case allows these cards to be inserted and removed easily.

Another familiar feature is the recess in the top of the case to take a monitor's tilt-and-swivel base, complete with a recess holding the four standard batteries for the real-time clock and calendar.

Opening the case and stripping the PC2086 down to the circuit board is a tedious task since, although the drives and the power supply are modular, they are hooked up with tangles of cables and surrounded by quantities of tough aluminium interference shielding. Amstrad could learn something from the PS/2 Model 30 when it comes to ease of maintenance.

The circuit board itself is neat, compact and in a finished state with no obvious kludged chips, links or extra components. It is also extremely simple and spacious, with heavy use of Amstrad-labelled custom glue chips.



Amstrad's monochrome analogue monitor provides a low-cost entry point for VGA graphics

The 8MHz 8086 and its associated 8087 socket are over to one side, next to the 640k standard RAM. This is organised rather oddly, with two single-in-line memory module (SIMM) slots holding 256k each, four 64kbits by four chips providing the extra 128k to make up 640k, and two 64kbit by one chips holding the parity data for this 128k. On the review machine the two SIMMs differed mightily from each other, one being the conventional small strip and the other being a much larger board, although both held nine 256kbit chips to provide 256k of parity-checked RAM.

Three large Amstrad custom chips separate the processor and memory section from the rest of the board, which holds the video circuitry, input and output controller chips and the Western Digital floppy disk controller hardware that manages both the internal and external floppy drives. The video hardware is built around the Paradise PVGA1A chip, which is register-compatible with the IBM VGA chip and has some extra display modes of its own, combined with 256k of video RAM on the motherboard and the now-standard Inmos digital-to-analogue converter and colour palette chip. A similar set-up, but with Paradise's EGA chip rather than the new VGA model, is used in the PC1640.

Using the PVGA1A gives the PC2086 all the standard VGA and MCGA display options, including 640 by 480 in 16 colours, 320 by 200 in 256 colours and so on. On top of that, Paradise has built in a 640 by 400 mode in 256 colours which allows users to display four VGA 320 by 200 images on the Amstrad screen at once. (It could have been 640 by 480 in 256 colours, but that breaks the 256k video RAM barrier.) Naturally, Amstrad has a demonstration software package to show this feature off.

However, Amstrad's implementation of the PVGA1A also means that the PC2086 requires a 640 by 480 analogue monitor, either monochrome or colour, to use the machine. Amstrad has designed a range of four new monitors to match the system (see the box 'Amstrad's new monitors'), and of course any VGA-compatible dedicated or multi-sync monitor can also be used now that the mains power supply for the computer is in its rightful place.

There are actually four expansion slots on the motherboard, although only three are accessible from outside the case, and the fourth is dedicated to the hard disk controller board just as it is in the PC1640. Amstrad has designed a set of new intelligent hard disk controllers for the new machines, each with a

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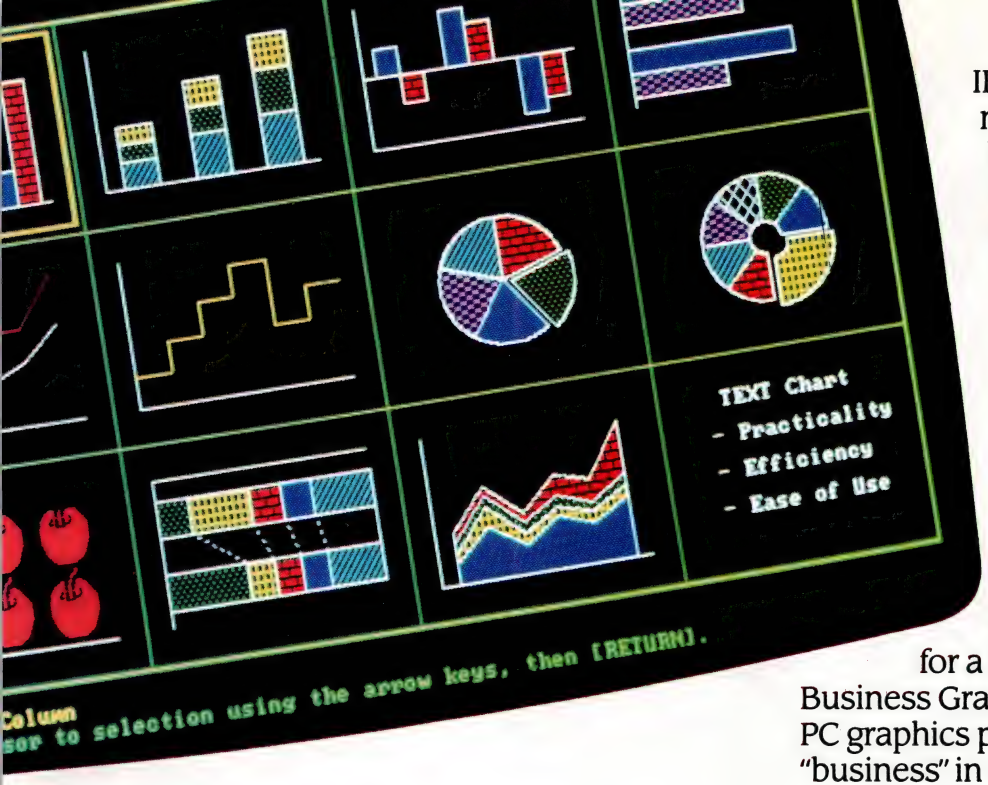
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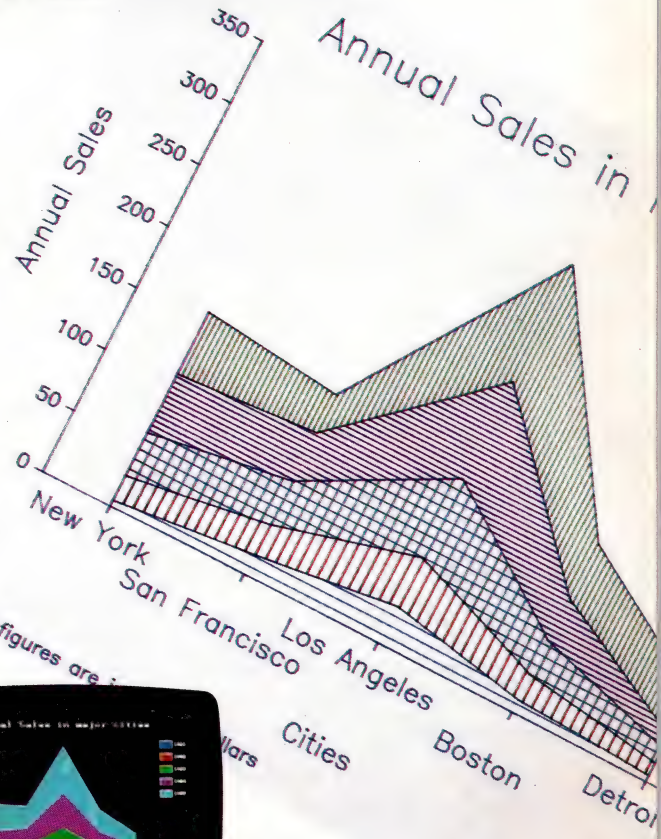
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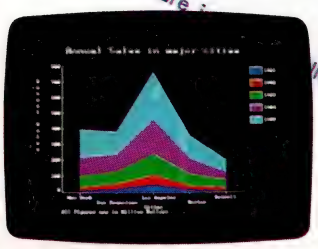
2

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Specification: system units

	2086	2286	2386
Processor:	Intel 8086	Intel 80286	Intel 80386
Clock speed:	8MHz	12MHz	20MHz
Wait states:	—	1	0.05
Full width main memory:	16bit	16bit	32bit
Numeric coprocessor socket:	Intel 8087	Intel 80287	Intel 80387
RAM (parity checked):	640k	1Mbyte	4Mbytes
RAM cache:	—	—	64k @ 35ns
Expansion slots:	3 by 8 bit excl HD	5 by 16 bits	5 by 16 bits
Asychronous bus operation:	√	√	√
Hard disk option with 1:1 sector interleave:	30Mbytes	40Mbytes	65Mbytes
Floppy drives:	720k	1.4Mbytes	1.4Mbytes
Built-in LIM 4.0:	—	√	√
RAM division option to conventional/ extended/LIM:	—	√	√
Novell NetWare (v2.0A) compatible:	Workstation	Server	Server
Microsoft — MS-DOS	3.3	4.0	4.0
Windows	2.03	286	386
GW-Basic	√	√	√
Dimensions: (mm)			
System unit — Width	365	415	415
Height	140	160	160
Depth	395	485	485
Keyboard — Width	475	475	475
Height	35	35	35
Depth	200	200	200

All machines have 5.25in, 3.5in and tape streamer connector; Hercules, CGA, EGA and VGA compatible graphics; bi-directional parallel printer port; battery backup clock and configuration RAM; mouse with Microsoft compatible .COM and .DRV; 101/102 AT-type keyboard; security lock on cabinet; volume control for speaker

microprocessor and 16k of RAM to act as a track buffer and offer a form of disk caching. The controller is smart indeed, since it is designed to work with run-length-limited (RLL) drives that normally offer increased storage densities and data transfer rates at the cost of possible controller incompatibilities and trouble with MS-DOS.

What Amstrad has done is to make the controller look to MS-DOS like a type of drive it knows about, using a standard ST506 interface, while the drive itself is a fast RLL unit. One consequence of this is that the drive characteristics reported by MS-DOS have nothing at all to do with its true physical characteristics. For example, on the review system MS-DOS was convinced that the 30Mbyte hard disk had six read/write heads while in fact it only had four.

The controllers also work with a 1:1 interleave factor, meaning that although the hard disk in the PC2086 has a slow access time of 85ms, its actual data transfer rate is 102k per second, 50 per cent faster than the PC1640's 20Mbyte drive and not far short of the PS/2 Model 30's 144k per second. As 1:1 interleave and RLL become more common in the PC business, data transfer rates — which are, after all, the true measure of disk performance — will become more significant than the sometimes misleading access time figures quoted now.

For comparison, the PS/2 Model 50's 20Mbyte drive manages a very fast 506k per second, while the IBM ATX runs at 169k and Compaq's DeskPro 386/16 transfers data from its 40Mbyte hard disk at 253k per second. And IBM's new, fast ESDI drives in the PS/2 Models 50Z and 70 can transfer 1Mbyte or more of data per second, regardless of their access times.

'Running more than one Windows application on the machine slowed things to a crawl as memory segments were paged out to he relatively slow hard disk.'

The development path from the PC1640 to the PC2086 is clear, and is acknowledged by Amstrad itself. The new machine is a PC1640 with all the latest features like 3.5in floppies, RLL hard disks and VGA displays. But Amstrad is keen to point out the features of the 1640 that have tended to be neglected in the past, but which will be pushed in the PC2086 marketing. For example, the Amstrad PCs have always used full 16-bit RAM, giving faster access than 8088-based systems at the same clock rate, and have also used less common 16-bit ROM architecture for BIOS and video ROM code.

Then there has always been a 'gearbox' glue chip between the processor and the bus, maintaining the bus at 4.77MHz for compatibility whatever the processor speed, and also offering 'posted writes' from the processor to the bus — a form of bus caching so that the processor can stuff data into registers in the gearbox chip and then get on with something else while the data is filtered out to bus devices.

On the PC2086 the video circuitry and the disk controllers are electrically on the expansion bus rather than on the motherboard (although they are physically on the motherboard) and are both 16-bit devices running at the full 8MHz processor speed.

Amstrad has also learned from the PC1640 experience with its new mouse and keyboard designs. Although it is encased in a rather bulbous and steeply raked case, the keyboard is now a perfectly standard IBM Enhanced layout type and has none of the peculiar keys like 'delete forward' which confuse PC users when switching to an Amstrad PC. The mouse is now completely Microsoft mouse compatible rather than nearly compatible, so there should be none of the frustration involved in trying to get Microsoft applications, in particular, running on the PC2086.

Apart from these changes, however, the keyboard still has the typical Amstrad wobbly-but-clacky feel and the mouse is exactly the same shape and size as that shipped with the earlier machines. The standard layout of the keyboard is what makes this one superior to its predecessors.

Overall, the hardware is what you might expect from a company designing an 8086-based system in 1988, with enough extra speed and standard feature wrinkles to make it stand out from the crowd. There is nothing wrong, in principle, with a PS/2 Model 30 clone.

System software

The review system came with MS-DOS 3.3. There are new DISPLAY utilities to



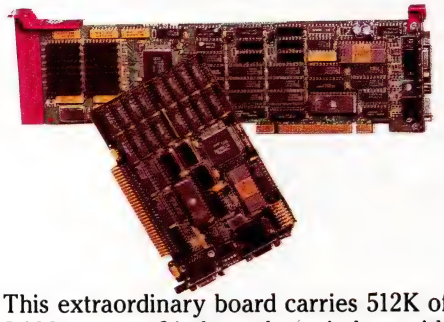
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handle the Paradise VGA chip's display modes including the CGA, EGA, MDA and Hercules emulations, although some of these emulations only offer slower BIOS-level compatibility rather than full register-level compatibility.

These utilities are now subsumed into a new utility called DEVICE, which not only shows the exact current hardware configuration, including port addresses, disk drive types, sizes and MS-DOS assignments, and video DIP switch settings, but which also allows these settings to be changed and stored in the system's non-volatile CMOS RAM.

This is certainly neater and quicker to handle than the SETUP program provided with most AT clones, and makes it simple to configure and reassign different types of external floppy drive, and to handle second video boards or modem boards that insist on being COM1:. Both MOUSE.COM and MOUSE.SYS drivers are provided for the mouse, to be used depending on what the application requires.

Every PC2000 machine comes with Microsoft Windows in its appropriate version: 2.03 for the PC2086, /286 for the PC2286, and /386 for the PC2386. No major changes have been made to the packages, except that the installation routines now offer the Amstrad settings — internal VGA display adaptor and Microsoft mouse — as the defaults.

In use

There is nothing earth-shaking about the performance of the PC2086. In fact, apart from the faster hard disk and higher-resolution graphics, our benchmarks show it behaves just like a PC1640 or a PS/2 Model 30.

One oddity about the speed testing was that installing the mouse driver produced strange timing results. Amstrad's design triples the clock-tick rate when the mouse is installed, so that the mouse pointer movement is smoother. The inclusion of Microsoft Windows can only have been to maintain compatibility across the PC2000 range, since an 8MHz 8086 is only marginally able to run Windows with any success, even with a 16-bit VGA interface to speed up the display.

Running more than one Windows application on the machine slowed things to a crawl as memory segments were paged out to the relatively slow hard disk. Because of this, I would recommend that resource-hungry and performance-sensitive Windows applications like Aldus PageMaker should be run alone on the machine or, better yet, not run at all.

'Amstrad has followed its usual procedure of giving the users what they want; in this case VGA graphics and 3.5in disk drives with faster 80286 and 80386 processors attached at the high end.'

But every other piece of software tried ran fine, including a protected version of 1-2-3 release 2.01A that required its key disk to be in drive A: for it to load. Reconfiguring the external 5.25in floppy supplied on the review system to be drive A: and using the excellent DEVICE utilities solved the copy-protection problem neatly.

The monitors were a mixed bag. The 12in monochrome unit, using grey-scales instead of VGA colours, produced a good display although the range of control provided by the contrast and brightness knobs was not wide enough to get a perfect one. The 14in low-resolution colour screen had some convergence problems with colour fringing or shading, at least on the review model, and the graininess of the display showed clearly as a result of the anti-glare coating.

The 14in high-resolution screen had similar but more minor convergence trouble, and the 12in high-resolution colour model was probably the best of the bunch for clarity and colour sharpness.

One helpful touch is that all the interface cables are extra-long, to suit those who want to stash the system unit away under a desk, and apart from the positioning of the mouse socket on the left-hand side of the machine — is designer Roland Perry left-handed? — the PC2086 is a neat and compact system.

Everything worked as advertised, at the expected speed, and this system should hold no surprises for experienced PC1640 users apart from a pleasant one: the improved keyboard layout.

PC2286

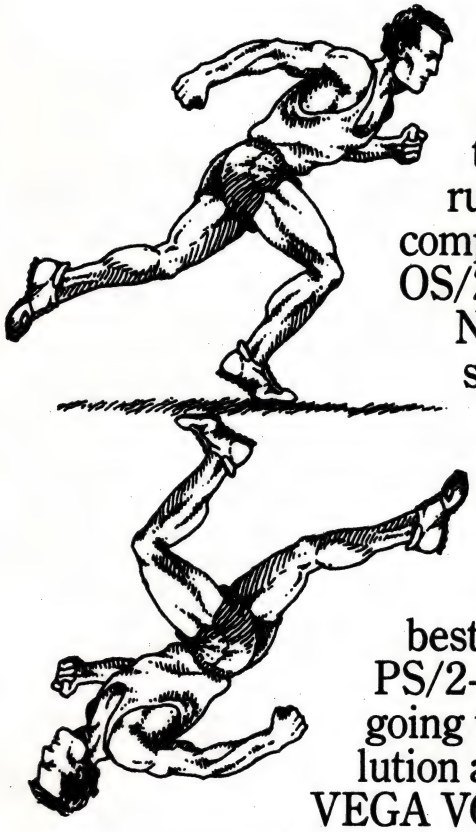
If the PC2086 looks like an over-inflated Xen, the PC2286 looks like an over-inflated PC2086. The casing is larger in all three dimensions than that of the PC2086, although the general structure and design is the same.

This is not really surprising, given how the machine is put together. The electronic hardware comes on two boards, piggy-backed but offset, rather like a flight of stairs. The bottom board is substantially the same as the PC2086 motherboard, with the processor and RAM removed and two sockets added to take the connectors of the second board. As a result, all the video hardware and interfaces are the same as for the smaller machine, and the positioning of the interface sockets is exactly the same. The major difference is that the PC2286 board offers five AT-compatible expansion slots rather than the three PC slots of the PC2086.

The second piggy-back board holds the 80286 processor, running at 12.5MHz, 1Mbyte of parity-checked RAM and very little else. The RAM is fitted in four SIMM sockets, all of which are occupied in the default configuration.

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The sockets can take megabyte SIMMs using megabit chips, so the maximum RAM expansion is to 4Mbytes with the drawback that the original 56k SIMMs need to be discarded. Any other RAM expansion would have to be done using expansion boards, with a consequent performance degradation. The 80286 runs with one wait state using the SIMM memory and two wait states using any other memory.

The PC2286 comes with support for the latest Lotus/Intel/Microsoft expanded memory specification, LIM EMS 4.0. Any part of RAM can be configured as expanded memory if required, including the extra 384k provided with the basic machine.

Two system configurations are available, one with twin 1.44Mbyte 3.5in floppy drives and one with a 40Mbyte hard disk replacing one of the floppies. The hard disk uses the same type of intelligent RLL controller as the PC2086, and so has a higher transfer rate than its access time of 40ms would indicate. External floppy drives storing 360k, 1.2Mbytes, and 720k in various sizes can be fitted to the external interface, as with the PC2086, but the PC2286 controller also supports an external 1.44Mbyte 3.5in drive.

System software

The PC2286 will come with MS-DOS 4.0 and Windows /286. The processor speed can be cut to 6MHz if necessary, and the same DEVICE utilities as in the PC2086 are used to control other aspects of the system.

Amstrad has not yet made a decision on whether to offer an Amstrad OS/2 for the PC2286 or PC2386, but in any case the 1Mbyte of RAM on the basic PC2286 is not enough to run any version of the operating system, let alone the Presentation Manager and Extended Edition. There is also no move planned to offer Xenix, although the PC2286 and PC2386 both now support Novell NetWare 2.0A — something that could not be said for the PC1640.

PC2386

When Amstrad set out to build the PC2386 it decided to go the whole way and build a true high-end business machine rather than a 32-bit system for the rest of us.

The PC2386 uses the same hardware structure as the PC2286, in the same casing and the same basic circuit board borrowed largely from the PC2086. The differences lie in the piggy-back processor board, which holds a 20MHz 80386 with 4Mbytes of RAM as standard, a custom cache controller chip handling

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64k of 35ns static RAM and a socket for the 20MHz 80387 numeric coprocessor.

Like Intel in the SYP-302 system, but for different reasons, Amstrad has decided not to use the Intel 82385 cache controller which is used in 80386 systems like the Compaq DeskPro 386/20, the ALR FlexCache and the Sun 386i. Instead, it has designed its own intelligent cache controller and implemented it as a custom chip. Amstrad claims that doing things this way gave the hardware designers more control over the architecture, and was cheaper than the 82385 solution in the kind of quantities Amstrad expects to be shipping. In any case, the company has always produced its own custom circuitry for its PCs — the gearbox chip handling asynchronous processor/bus communication is one example — and Amstrad probably thought of the DIY solution automatically.

The cache controller actually caches every type of memory in the system, including the BIOS ROMs, and Amstrad claims that this, combined with the fact that the PC2386 BIOS ROMs are a full 32 bits wide, makes it unnecessary to copy the ROMs into fast 32-bit RAM for better performance. The company engineers did not like losing any user memory for BIOS copying, and were not confident that it could be fully protected from ill-behaved applications. The 32-bit BIOS ROMs contain the video BIOS for the built-in Paradise VGA circuitry as well as the system BIOS, which also speeds up BIOS operations.

The cache actually works by copying 64k from main RAM or ROM into the cache at each memory access, so that most subsequent accesses will hit the cache rather than incur the speed penalty of going to main memory. The idea is that few program loops or data structures will be larger than 64k, so that the cache will give zero-wait-state access to data 95 per cent or more of the time.

The usual Amstrad posted write system for bus transfers also helps the rest of the system in its attempt to keep up with the 80386.

There are four RAM SIMM slots, which in the basic configuration hold megabyte strips of parity checked memory using megabit chips. As with the PC2286, memory expansion is only possible by using larger chips, and only then by throwing out the existing SIMMs. Expansion to 16Mbytes will be possible using the 4Mbit RAM chips which are becoming available in small quantities at high prices, but for now expansion requires a 16-bit board plugged into one of the machine's five AT-compatible expansion slots.

This is certainly a drawback with the system, since 16-bit RAM access with an 80386 is slow at the best of times and worse when the bus is being run at 8MHz for AT compatibility, as it is in this case. Although 4Mbytes of standard RAM is great for MS-DOS users, it is only just about enough to run OS/2 with Presentation Manager, and not enough to run the character-based Extended Edition successfully.

Those contemplating Xenix, or using the PC2386 as a file server, will also find 4Mbytes a limitation rather than an advantage. But for current MS-DOS users, the built-in LIM EMS 4.0 support means that all the RAM can be used, and with Windows/386, multiple MS-DOS applications can be run simultaneously using the 4Mbytes as extended RAM.

Only one system configuration is available, using a single 1.44Mbyte 3.5in floppy and a 65Mbyte RLL hard disk drive using the same type of track-buffering smart controller as the other two machines. This drive has a 40ms access time, which looks slow for a fast 80386 system; but again, the RLL controller and buffering mean that the data transfer rate is fast, although the exact figure was not available at press time.

All the other interfaces are the same as for the PC2086 and PC2286, so that the PC2386 has the same external floppy disk choices as the 80286-based system and the keyboard, mouse and monitor options are also the same.

Specification: monitors

	PC12MD	PC14CD	PC12HRCD	PC14HRCD
Screen size (diagonal):	12in (30.5cm)	14in (35.6cm)	12in (30.5cm)	14in (35.6cm)
VGA:	√	√	√	√
PS/2 compatible:	√	√	√	√
Resolution — dot pitch	—	0.42	0.28	0.29
— 640 by 450, 400 by 350:	√	√	√	√
Tilt and swivel base:	√	√	√	√
Antiglare:	√	√	√	√
Up to 256 colours on-screen	—	√	√	√
Automatic conversion to 64 shades of grey	√	—	—	—

System software

As with the other systems, the PC2386 comes with a combination of MS-DOS 4.0 and Windows, in this case Windows/386, and a set of DEVICE utilities to configure the system and alter the processing speed from 20MHz to four, five, seven or 10MHz depending on what software needs to be run. There is nothing else special about this MS-DOS version, and Windows/386 is too well-known to require any closer examination.

As with the PC2286, use of OS/2 or Xenix is left up to the user since Amstrad has no official plans to support either operating system itself.

Conclusion

Amstrad has followed its usual procedure of giving the users what they want; in this case VGA graphics and 3.5in disk drives with faster 80286 and 80386 processors attached at the high end. The PC2086 will inevitably be seen as a replacement for the PC1640, and so it is, but Amstrad insists that it will continue to sell the PC1640 as it is, with GEM rather than Windows, but probably at a lower price to undercut the PC2086 by a wider margin.

The PC2286 and PC2386 are enigmatic machines. Amstrad wants more of the corporate market than it already has, and wants reputable dealers to sell and support these more powerful systems. Technically, they are a mixture of typical Amstrad innovation and restrictions. The external floppy port is an excellent idea, as are the smart disk controllers, but the limited RAM expansion on the PC2286 and PC2386 motherboards is going to cause trouble for users in the future.

It's a good range, more compatible with the IBM PC and PS/2 standards than the earlier PCs and offering a clear growth path. Amstrad expects to weather the turn from a volume-dealer box-shifter to a high-end systems supplier with its usual panache.

END

At the time APC went to press, pricing for the Amstrad PC2000 series was not available. Pricing comments in this test are based on announced PC2000 prices versus PC1640 prices in the UK.

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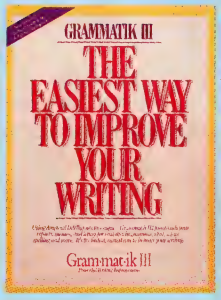
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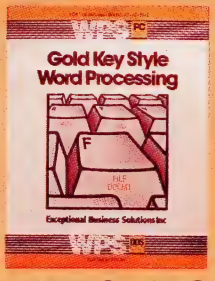
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Turbo Prolog revisited

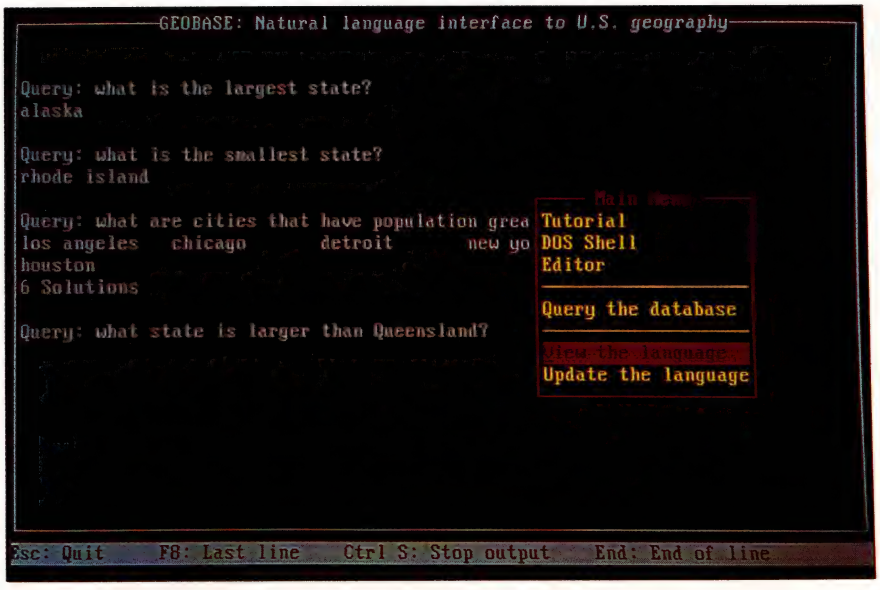
Version 2.0 of Turbo Prolog offers enhanced database and graphics features. Alex Lane finds it has become a mature environment for logic programming.

Programming languages and their implementations fuel endless debates within the microcomputing community. Should an implementation provide precisely those features set forth in the language's definition, or should it alter that definition for the convenience of the implementer and the user? Borland International's language products — mentioned often in such debates — fall into the latter camp, and its Prologs are no exception to the rule. Turbo Prolog 2.0 stretches the language even more than did the original Turbo Prolog 1.0.

Borland's Prologs enforce strong typing of objects and relations (Edinburgh Prolog, the de facto standard, doesn't) and limit the assert and retract mechanism to facts alone (Edinburgh supports dynamic modification of facts, predicates that define relations, and rules involving those predicates).

Despite these impurities, Turbo Prolog has found a follcwing. Users appreciate features like fast compilation, linkage to standalone .EXE, foreign-language compatibility, integrated edit and debug facilities, and the rich assortment of built-in predicates that work with numbers, strings, files, windows, the Prolog database, and the DOS environment. Turbo Prolog 2.0 upgrades these capabilities and breaks significant new ground in two areas — graphics and the database system.

Though straightforward, the installation process isn't completely intuitive. For example, to install it on a hard disk you must make the hard disk drive, not the floppy disk drive, your default drive. In my opinion, that detail should be transparent to the installation routine. Once begun, installation of Turbo Prolog is a mindless, disk-swapping affair. Many of the files are bundled into archives; the installation program spends most of its time unarchiving them. At the end, it reminds you to insert the commands FILES = 20 and BUFFERS = 40 into the CONFIG.SYS file.



You'll need just under 1.5Mbytes of free space on your hard disk to install all the files that come with Turbo Prolog 2.0. A root directory contains the compiler, the core library PROLOG.LIB, the librarian, and the linker. Five subdirectories contain Borland Graphics Interface (BGI) drivers and font files; all the sample code shown in the documentation; answers to tutorial problems; model Prolog applications like Geobase (a geographical database that supports natural-language queries) and the Prolog Inference Engine (PIE), an Edinburgh-style Prolog interpreter written in Turbo Prolog; and reference examples comparing the use of the old and new standard predicates.

To use Turbo Prolog 2.0, you'll need an

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IBM PC, XT, AT, PS/2, or true compatible, PC-DOS or MS-DOS 2.0 or higher, and a minimum of two floppy disk drives and 384k of memory. Such a system would be barely usable (the installed Turbo Prolog would be spread out over five disks), so I wholeheartedly agree with Borland's minimum recommended system — a hard disk drive and 640k of RAM. I evaluated the package on a 16MHz '386-based PC equipped with a multi-scan monitor, a hard disk drive and 512k of RAM, and also on a 4.77MHz IBM XT equipped with a CGA, a hard disk drive, an 8087 numeric coprocessor, and 640k of RAM.

General improvements

Most Turbo Prolog 1.x programs will compile unchanged. Those that won't are ones that refer across module boundaries to domains, databases, or predicates; you must now explicitly declare these elements to be global. Also, version 2.0 assumes that global predicates are deterministic (ie, not expected to generate multiple solutions). That assumption enables the compiler to emit more efficient nonbacktracking code in situations that don't require backtracking. You must qualify a global predicate with the keyword 'nondeterm' to make it nondeterministic.

The files domain now supports 'stdin', 'stdout' and 'stderr'. These names, familiar to C programmers, enable Turbo Prolog programs to communicate with other programs by means of DOS pipes. C programmers will also appreciate new directives for conditional compilation ('ifdef', 'ifndef') and the capability to define constant expressions.

You can log the debugger's output directly to a file or printer. This feature really helps when you're trying to track down strange program behaviour in the middle of a trace. You can enable or disable run-time checks for integer and stack overflow, and you can control the size of the heap available to a compiled Prolog program.

TLIB, the librarian, stores predicate object modules in library files. I use it to reduce disk clutter. By archiving source code on floppy disks and storing the corresponding object code in a library, I minimise the number of .PRO files in my Prolog environment.

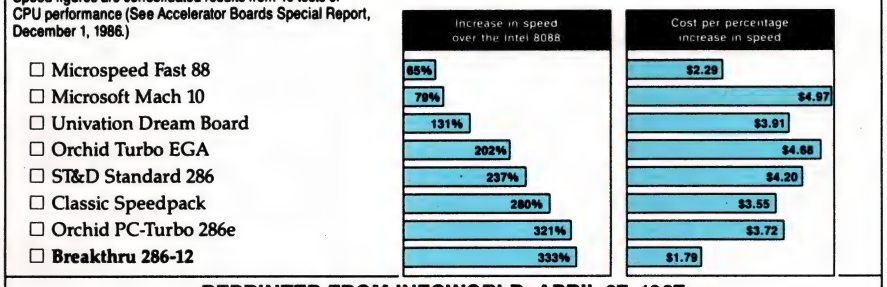
Several command-line parameters are now available with Turbo Prolog. The -e flag loads a specified file into the editor; by default, it loads WORK.PRO. The -s flag loads a setup (.SYS) file. You can enable or disable snow-checking with -c, and the -x flag enables Turbo Prolog's high resolution text modes (43 or 50 rows by 90, 120 or 132 columns).

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Speed figures are consolidated results from 10 tests of CPU performance (See Accelerator Boards Special Report, December 1, 1986.)



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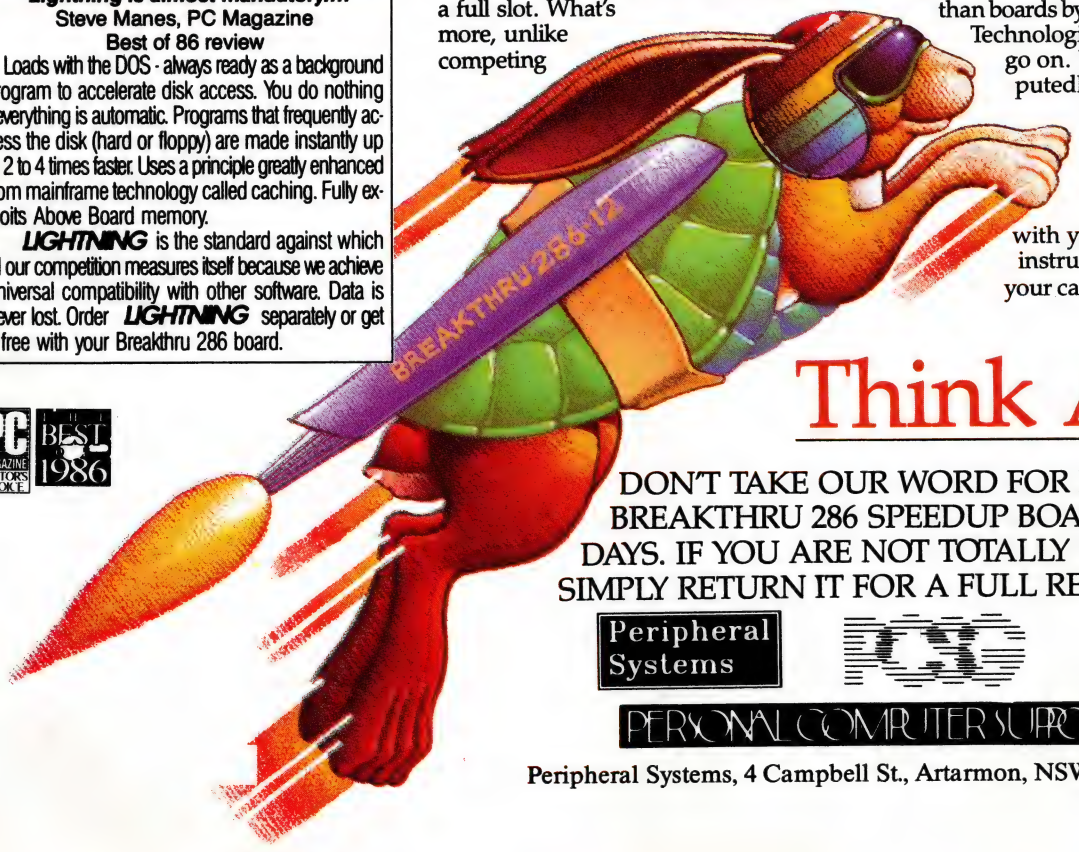
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The syntax of the language has been changed in ways that move it closer to traditional Prologs. Comments, which in version 1.x programs required the C idiom /*...*/, can appear as the remainder of any line that begins with a per cent sign. Predicates can now have multiple arities. For example, a predicate called 'sales_contact' might have two forms, one describing a name and address relation and another describing a name, address, and phone number relation. In documentation, you'd write 'sales_contact/2' and 'sales_contact/3'. In code, you'd write 'sales_contact' and let the compiler choose, based on the number of arguments supplied.

Many of the standard predicates now have multiple arities. The 'makewindow' predicate, for example, has two forms: 'makewindow/8' does the basic job, and 'makewindow/11' adds control over the style of the frame and position of the title. Some new standard predicates are 'bios/4', which returns the status of flags; 'edit/13', an upgraded version of the original 'edit/2' facility that gives Prolog programs access to the Turbo Prolog editor for complex I/O; and 'exit/1', which sets the DOS 'errorlevel'.

	Source file	.EXE file		Memory compile		Compile/ link		Run time	
	(bytes)	(bytes)		(seconds)		(minutes:seconds)			
Test		1.1	2.0	1.1	2.0	1.1	2.0	1.1	2.0
Floating point	635	35,503	32,436	2	2	0:15	0:18	0:30	0:36
List reversal	908	35,854	29,923	2	2	0:15	0:18	0:23	0:11
Sieve	973	35,790	26,323	2	2	0:15	0:18	0:03	0:03
Math	1456	38,526	33,251	5	4	0:17	0:21		
sqrt								0:05	0:06
ln								0:14	0:14
exp								0:24	0:24
atan								0:15	0:16
sine								0:16	0:16
Factorial	656	35,546	37,055	2	2	0:14	0:17	0:21	0:31
Towers of Hanoi	677	35,478	29,067	2	2	0:14	0:17		
10 rings								0:85	0:16*/0:34**
7 rings								0:11	0:02*/0:04**
5 rings								0:03	0:01*/0:01**
Disk write	605	36,425	27,854	2	2	0:14	0:17	0:29	0:29
Disk read	470	36,444	30,625	2	2	0:14	0:17	0:16	0:16

* Snow-checking off.
** Snow-checking on.

Table 1 Turbo Prolog lags behind version 1.1 on number-crunching tasks but betters its predecessors in symbolic computation

Database support

The database portion of Turbo Prolog has been almost completely re-designed. In the old scheme, a single internal database served as the repository for facts. You filled it from three sources: database predicates in source code; database predicates stored in a separate file and accessed by means of 'consult'; or 'assert' predicates contained in clauses or a goal. The 'retract' predicate deleted a fact and 'save' wrote the contents of the database to an external file. Available RAM limited the size of the run-time database. Although the 1.x documentation hinted at a way to virtualise the database, it was disk-intensive and involved a laborious indexing scheme.

Version 2.0 preserves and extends the internal database facility. Now you can name multiple internal databases, and you can consult or save each separately. New versions of 'consult', 'save', 'assert', and 'retract' work with these named internal databases. To use a database across module boundaries, you must declare it in the global database section and declare its predicates in the global predicates section. As before, the amount of RAM limits the size of internal databases.

The new external database implements a virtual store of facts. You can put an external database in RAM or expanded memory, if there's room, or you can put it on a disk file. An external database is made up of one or more chains (linked lists) of terms and, for each chain, an associated B+ tree is used to index it. New predicates, analogous to 'save', 'consult', 'assert' and 'retract', work with external databases. The specialised accessors 'db_chains' and 'chain_terms' bind entire chains or individual terms to Prolog variables during backtracking. You can use the 'bt_' (B+ tree) predicates to sort chains and gain fast keyed access to terms.

The internal and external databases aren't compatible with one another. You can't use 'assert' or 'retract' with an external database, nor can you chain internal predicates. But that's logical, since terms belonging to an internal database are actually part of a Prolog program, while terms belonging to an external database are data manipulated by that program. This arrangement isn't unique to Turbo Prolog 2.0. Arity/Prolog 4.0 implements something quite similar. The Turbo Prolog 2.0 documentation devotes a full chapter to external databases. Sample programs clearly illustrate how to scan, update, restructure, protect, and display them.

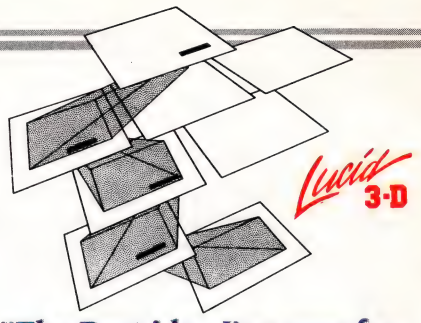
Borland Graphics Interface

If you've had a chance to play with Turbo Pascal 4.0, you're probably familiar with the BGI. The BGI comes with Turbo Prolog 2.0 as well. It supports CGA, MCGA, EGA, VGA, Hercules, AT&T 400-line, 3270 PC and IBM 8514 graphics adaptors. Turbo Prolog 2.0 offers more than 70 new standard predicates; they create and manage viewports (graphics windows), draw shapes such as circles and rectangles, and define patterns used to fill shapes. All these new features get a workout in the sample program GRDEMO.PRO. Though at first graphics and Prolog might seem an odd mixture, I can think of some interesting applications combining the two. A system of artificial intelligence-based controls for a water treatment plant could graphically represent water levels and flow patterns. A circuit-board trouble-shooter could illustrate where to put logic probes, or could display waveforms.

There are two ways to package code that uses the BGI. The easiest way is to compile and link the Prolog program, then run the resulting .EXE file in the presence of the drivers (.BGI files) and fonts (.CHR files). The disadvantage here is that the program has to be able to locate these files. Alternatively, you can use the new 'bgidriver' and 'bgifont' compiler directives, which specify the drivers and fonts you want to attach to your program. This approach consolidates your application into a single file. But that file is substantially bigger — a program that incorporates all the drivers supplied with the package grows by almost 30k.

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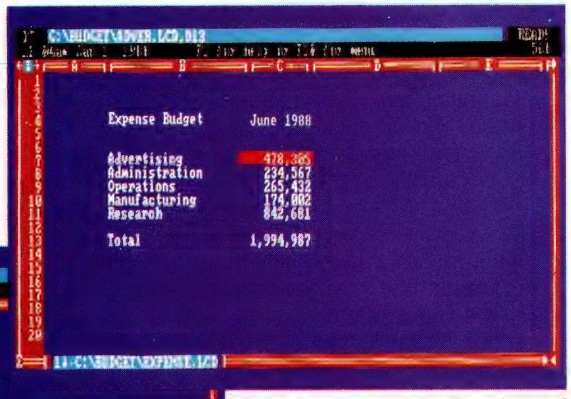
You can pop Lucid up instantly while working in your word processor or any other program. You can cut anything on the screen and paste it right into Lucid, or cut anything from a Lucid worksheet and paste into the application below. You can even run Lucid on top of 1-2-3 if you like, and cut and paste information from one to the other, including formulas.

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Another 3-D feature is that any cell can also contain a multiple page note window that you instantly access with a single keystroke. You can write notes, memos or letters that relate to your work, save them as individual files and even print them separately or with your spreadsheet.

Other Features

Lucid has over 100 innovations that cause users to say it is the best of all the spreadsheet offerings! Things like: **Speed** - background, minimal and visible recalc. **Macros** - learning macros, autoexecute macros, macros work between spreadsheets, user defined macro menus. **Mouseability** - total Mac-like mouse access, but easy keyboard control as well. **Color or Mono** - 17 user controlled color displays. **Audit** - six displays and printouts. **Windows** - multiple sheets on screen at same time. Multiple views of the same sheet. Pop-up windows of function formulas, range names, favorite labels, macro names, filenames, even a calculator. All let you select and insert right into your spreadsheet. All windows (even notes) resize and move where you want them. **Cut and Copy** - between spreadsheets, documents and between sessions. **Help** - press F1 anywhere, you get help specific to what you are doing.



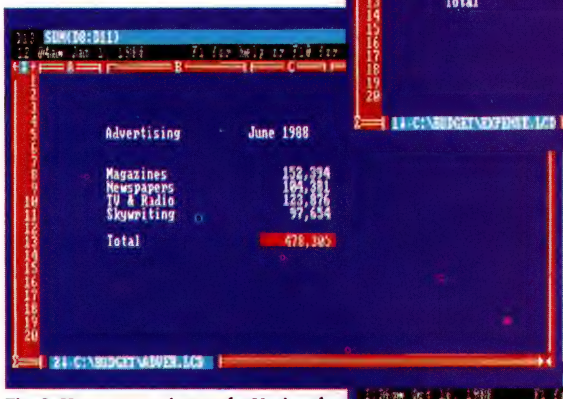


Fig. 1. Let's get the detail on those ad costs, just move the widebar to that cell and press one key (grey +).

Co-Winner of the 1987 PC Magazine Award for Technical Excellence
The other winner: Microsoft's Excel

Fig. 2. Here we are instantly. Notice the lower left corner showing we are on level 2. Grey – takes you back. There is no limit to the levels you can go. Move right down to transaction level if you like.

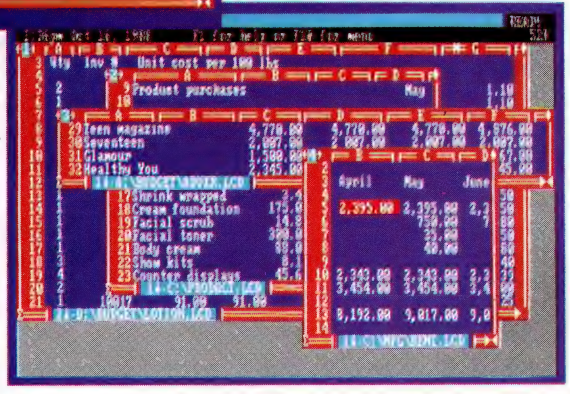


Fig. 3. Of course, Lucid does multiple windows. Notice, you can simultaneously open windows in different directories, different drives, even down as many 3-D levels as you like. No one else can do that.

Masterwork

Lucid is more than a bag of features. It is a masterwork. The overall feel is tight and polished. In fact, Paul Somerson, executive editor of PC *Magazine*, used one word to describe it, "*Slick*".

PCSG has built an excellent reputation as a developmental laboratory. Now those who have worked with Lucid 3-D tell us "*you have done it again. This is software everyone should have.*"

Even if you don't plan to abandon 1-2-3, Lucid makes sense. Files are converted between them with ease so there's not an interoffice compatibility problem. This means you can have the power and fun of Lucid 3-D, without having to upset your present systems.

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Foreign languages

Though version 1.x could link Prolog programs with external routines written in foreign languages, the feature never worked to my satisfaction. Happily, version 2.0 is fully compatible with Borland's Turbo C. You can write C routines that support Prolog predicates as before. You can even call Prolog predicates from C; the catch here is that the main program must be implemented in Prolog, so Prolog can control the stack and heap.

Not having a current version of Turbo C at hand, I linked a simple C routine compiled under Microsoft C (version 5.0) with a program written in Turbo Prolog 2.0. Despite a few complaints from the linker about undefined symbols, I could call the routine successfully from Prolog. Despite all this, I remain sceptical about the usefulness of the language interface. In theory, it's a great way to subcontract computing tasks that Prolog doesn't handle well, like numerical analysis and sophisticated string handling. In practice, you have to own another Borland language product, and you need more than a passing acquaintance with concepts like memory models.

Sample programs

Turbo Prolog 2.0 comes with a wealth of sample programs. These serve two purposes: they teach Turbo Prolog by example and, more generally, they motivate the study of some classic problems that Prolog helps to solve. Borland, as always, provides source code for these applications so you can study and try to modify them. In a welcome change from version 1.x, the documentation describes these applications.

Geobase is a database that contains information about the geography of the United States and a natural-language query facility that lets you ask questions like "What is the largest city in Mississippi?" The documentation tells how to compile and link the program, outlines its architecture, and suggests how to extend it to other domains. SEN_AN, a sentence analyser, uses a context-free grammar to parse simple English sentences. GENI, an expert-system shell, comes with a small knowledge base containing definitions of various kinds of animals. In consultation with GENI, you specify an animal's attributes (eg, 'has feathers', 'doesn't have long legs'), and the program seeks to identify the animal in question. GENI has an update mode, too. When it can't identify the animal you have in mind, the program can help you add it to the knowledge base. The documentation, again, suggests ways for you to extend the application into other domains.

The PIE impressed me most of all. PIE is a small but powerful Prolog interpreter that, unlike Turbo Prolog itself, permits the user to assert and retract both facts and rules. The appendix that describes PIE is dense and, at times, patronising of traditional Prolog implementations, but nonetheless it's an education in the esoteric art of Prolog interpretation. The program does have its bugs. I noticed that when goals are resatisfied during backtracking, the trace window displays the old instantiated variables rather than anonymous variables. In addition, I had to reboot my XT with a DOS-only disk in order to compile PIE with the trace mode enabled. Nevertheless, I was able to load and run an unmodified copy of the Prolog chestnut QUEENS4.PRO.

At a glance

Turbo Prolog 2.0
Supplier: Tech Pacific
Tel: (02) 662 4122
Price: $197
Requires: IBM PC, XT, AT, PS/2, or true compatible; 384k of RAM (640k of RAM recommended); dual floppy disk drives (hard disk drive recommended).
In short: A useful implementation of Prolog, Turbo Prolog 2.0 breaks significant new ground in two areas — graphics and the database system. A mature environment for logic programming.

Nearly 1000 pages of high-quality documentation accompany the software. That's a great improvement over the version 1.x manual in terms of both quantity and quality. The new documentation set divides into two hefty tomes: a 480-page user's guide and a 462-page reference guide. The user's guide explains how to install the package on your computer, how to set up the environment, and how to get started with the editor. Then it dives into Prolog. Topics include backtracking, unification, lists, recursion, strings, windows, files, graphics, databases, and debugging.

Most of the reference guide is devoted to the description of version 2.0's standard predicates. The rest of the book features a programmer's guide, a list of error messages, and a series of appendices describing the applications that come with Turbo Prolog 2.0.

Better performance?

For testing purposes, I used a 4.77MHz IBM PC XT with a hard disk drive, an 8087 coprocessor, and 640k of memory. The floating-point tests measure the time required for 5000 iterations of a set of floating-point multiply and divide operations. The list-reversal test, adapted from a Lisp benchmark, clocks 30 reversals of a list of 50 integers. The Sieve of Eratosthenes finds all the prime numbers between one and 100, 10 times. The maths benchmark performs 1000 calculations each of square root, natural logarithm, exponential, arctangent, and sine functions. The factorial test computes 10! 1000 times. The Towers of Hanoi benchmark writes a narrative description of the solution to that puzzle for 5, 7, and 10 rings. Finally, the disk read and write benchmarks write a 64k file to a floppy disk drive and read it back.

Version 2.0 produced code that was 20 to 30 per cent smaller than that produced by version 1.1 (see table 1). Somewhat surprisingly, 1.1 outperformed 2.0 on the maths-intensive benchmarks. That result doesn't particularly concern me however; Prolog isn't a number-crunching language. If you need those capabilities in a Prolog context, consider linking appropriate routines written in assembly language or C. Prolog's strength is symbolic computation, and on those benchmarks — the list- reversal test and the Towers of Hanoi — 2.0 significantly outperformed 1.1. The results for the Towers of Hanoi with and without snow-checking, by the way, show the rate of text output to the screen to be an important limiting factor.

A mature environment

Like its predecessor, Turbo Prolog 2.0 isn't a traditional Prolog; the language is strongly typed and doesn't let you dynamically assert and retract rules. But logic programmers aren't necessarily complaining. Many, for example, support Turbo Prolog's strong typing. In any case, as Prolog implementations proliferate, it's getting harder to point to a definitive standard.

Turbo Prolog 1.0 was a useful and popular implementation of Prolog. Borland International has raised Turbo Prolog 2.0 a cut above that. The external database puts serious knowledge-crunching capability into the hands of Turbo Prolog programmers, and the BGI features should yield some interesting graphical applications. Traditional it may not be, but Turbo Prolog has certainly become a mature environment for logic programming.

END

THE ADVANTAGE



ENHANCED

Kaypro Corporation — electronics innovator since 1952 — has made a good thing even better. The KAYPRO 286i Model C now features a 40-MB hard drive and the 101-key AT-style keyboard. With the latest standard feature enhancements, the KAYPRO 286i is the smartest choice in advanced computer technology.

Advanced.

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And Enhanced.

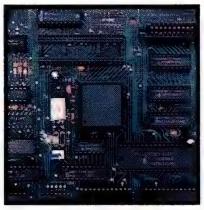
The KAYPRO 286i Model C has a 1.2-MB floppy disk drive, plus a hard disk with 40 MB of storage. The KAYPRO 286i AT-style keyboard features the new 101-key layout with separate cursor control, numeric keypad, and 12 programmable function keys.

Perhaps the nicest surprise about the KAYPRO 286i/C is the suggested retail price of $4895 You won't find distinctive metal construction, 12MHz processing, and free name-brand software that includes WordStar Professional Release 4 in any other AT-type computer. Other company's extras are Kaypro standard features.*

* *Prices are subject to variation*

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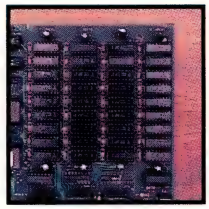
80286, 12-MHz Microprocessor.



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Enhanced 101-key IBM PC/AT-style keyboard with security keylock.



640 KB of RAM; expandable to 15 MB.



Bundled software includes WordStar Professional Release 4.

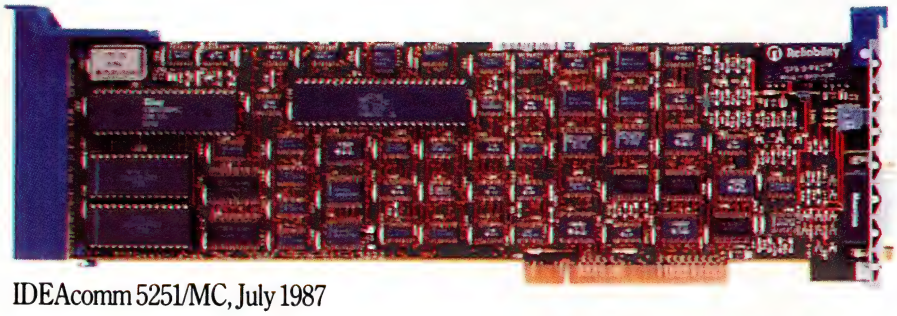
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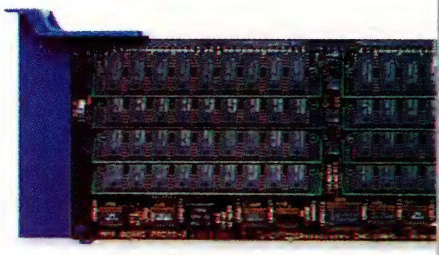
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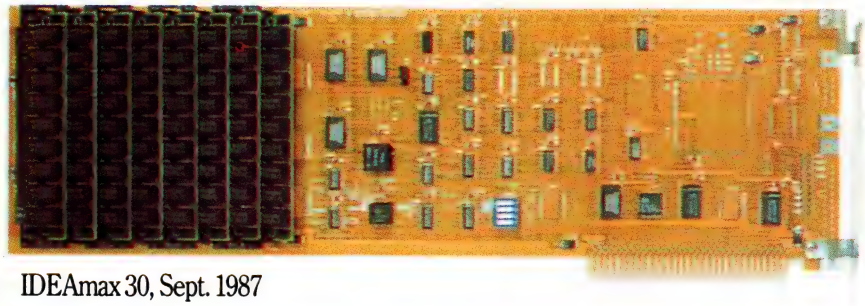
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we're the first t



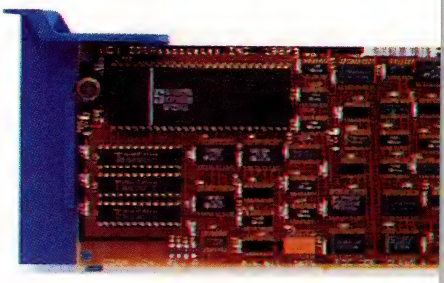
IDEAcomm 5251/MC, July 1987



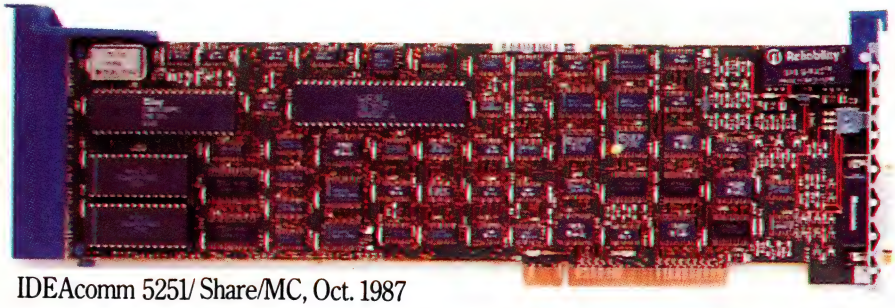
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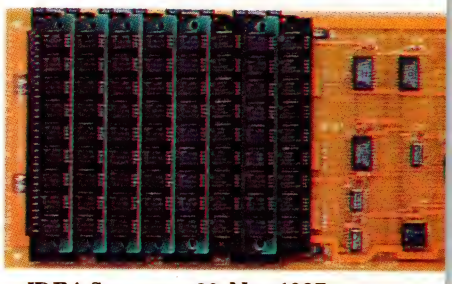
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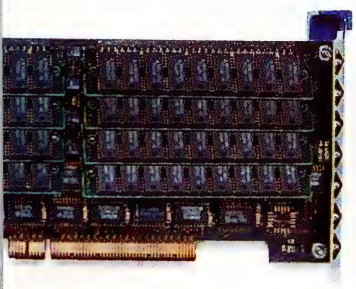
On April 2, 1987, IBM brought the world to a standstill when it brought the PS/2 to life.

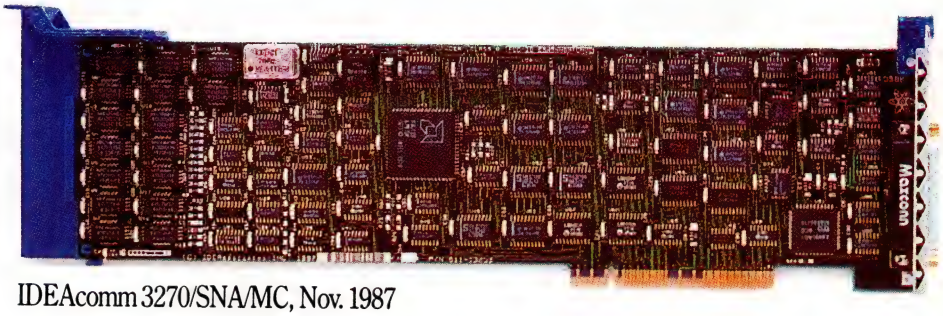
Now while everyone else waited to see how this latest offspring would be accepted, we quietly set out to create products that would help the PS/2 reach its fullest potential. And two months later, we delivered.

In fact, we were the first to devise completely functional local and remote links between the PS/2 and System 3X minicomputers. First to offer local and remote gateway communications for the PS/2 on a local area network. And first with a Micro Channel® board that adds up to 12 megabytes of memory.

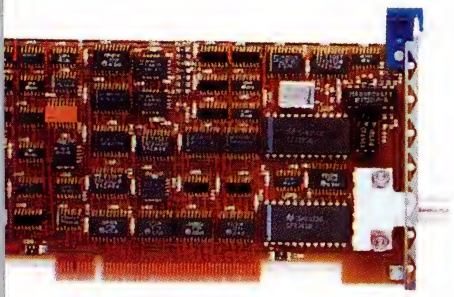
Our list of firsts didn't start with the PS/2, either. For example, we pioneered the industry standard in backplane design for multifunction boards. And we were the first to fully apply surface mount technology, which allowed us to put all the basic computing functions onto one PC board. (Interestingly enough, a year later IBM

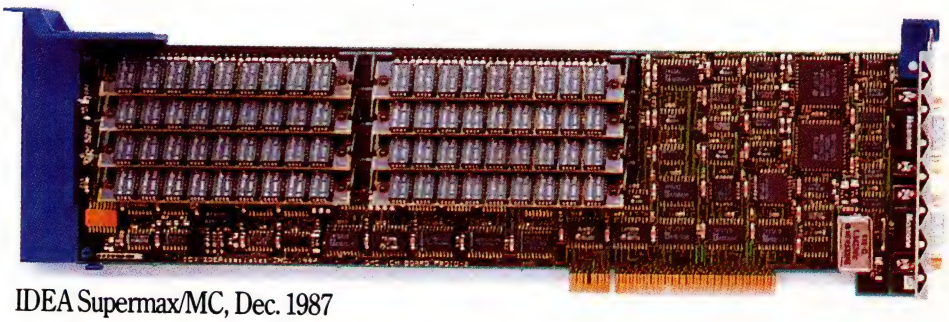
es birth to a new PC, o send out cards.



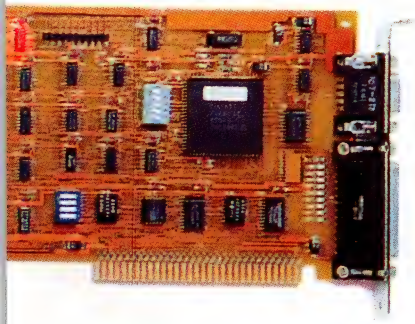


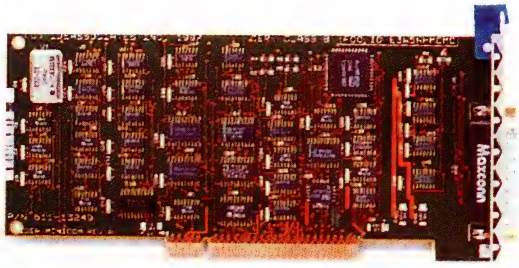
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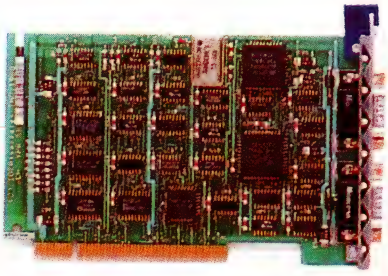


IDEA Supermax/MC, Dec. 1987





IDEAcomm 5250/Remote Gateway/MC, Dec. 1987



IDEAmini/MC, May 1988

used surface mount technology to create the PS/2.)

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Leveraging RAM with LIM 4.0

The LIM 4.0-compatible memory boards evaluated by APC will let you break DOS's 640k barrier today. Winn Rosch finds it will also gear you up for the move to OS/2.

Face it. Since you got your PC those untold years ago, your problems have become bigger, not smaller. Not that your PC causes your headaches — rather, the machine has made you so much more efficient that you're tackling challenges of increasing difficulty.

Your PC, however, has not kept pace. No matter whether you've just invested in the most powerful PS/2 or are still using your original PC-XT, most of the applications you want to run still must fit within the confines dictated by DOS — 640k of memory.

Those widely touted ultimate solutions won't help. The latest 80386 operating environments only let you run more, not bigger, applications. The promises made for OS/2 won't solve your problems of the present either. More a religion than an operating system, OS/2 still awaits the coming of a new world and a new order.

On the outskirts of DOS, however, lies an answer. In August 1987, a new expanded memory specification (EMS) was announced, replacing the original EMS 3.2 that dated back to August 1985.

Called either EMS 4.0 or LIM 4.0 (after Lotus, Intel and Microsoft, the progenitors of the original version), the new memory-handling technique offers a double-barrelled combination of virtues. First, it gives you a huge memory area, one that stretches 32Mbyte wide — twice the direct addressing range of the 80286 microprocessor. Unlike memory handling under EMS 3.2, both program code and data can use the expanded memory area under the new version. Second, LIM 4.0 is already supported by dozens of applications because it's completely compatible with both EMS 3.2 and the enhanced EMS that was originally promoted by AST Research, Quadram and Ashton-Tate. That means you can put LIM 4.0 products to work today.

There's a catch, of course. Making LIM 4.0 work requires LIM 4.0-compatible hardware. If you have a PC, an XT, or an AT, you'll probably need a new memory board even if you're already equipped for EMS 3.2. Because LIM 4.0 uses new registers and different memory-handling techniques, ordinary EMS 3.2 memory products can't bring many of the advanced features of LIM 4.0 to life.

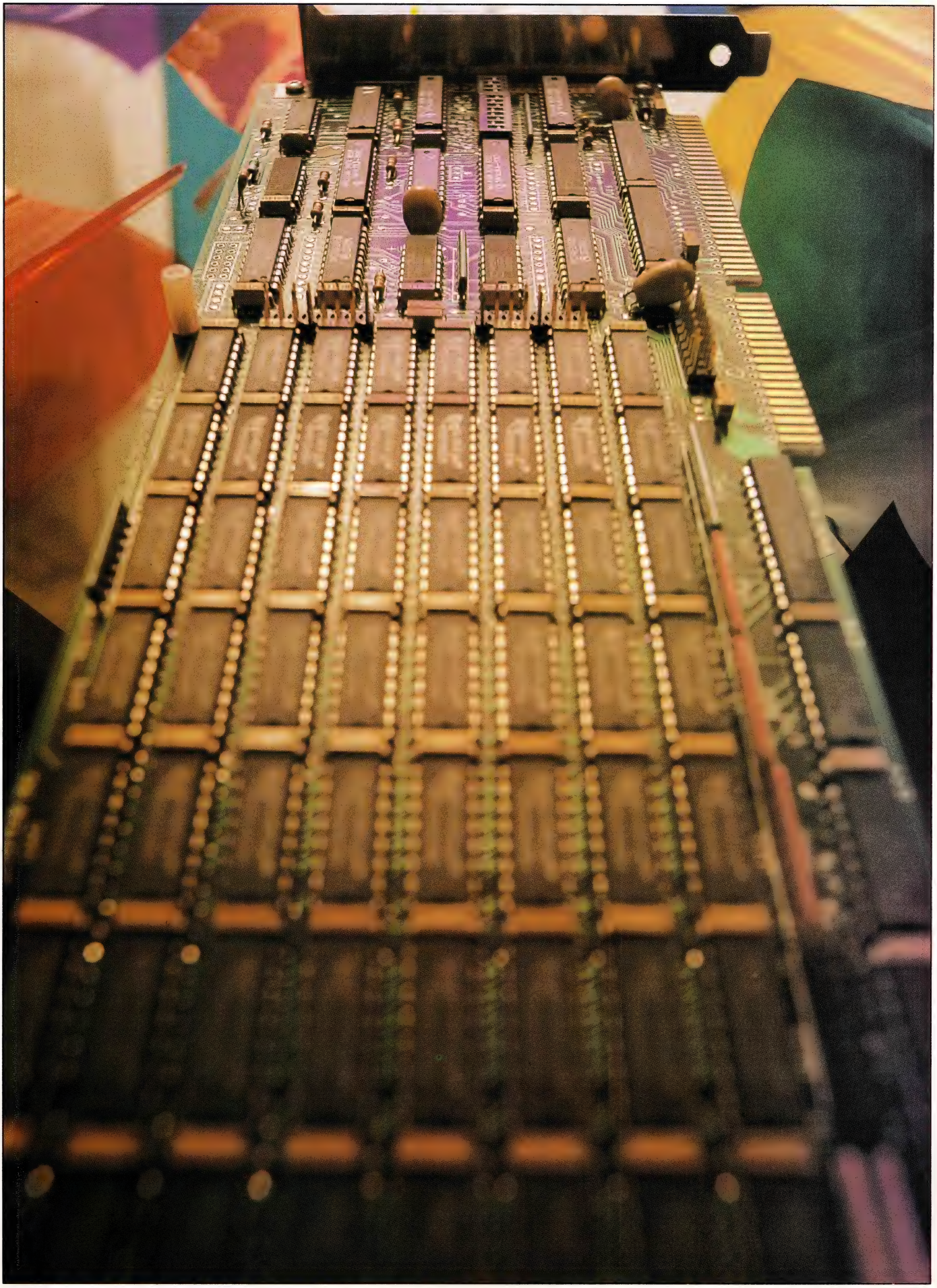
On the other hand, EEMS memory boards come close enough to meeting the demands of LIM 4.0 that you can add the power of the new memory standard to many of them just with new driver software.

The situation with Micro Channel PS/2s is even more promising. By virtue of their built-in memory-banking capabilities, these machines can be upgraded to LIM 4.0 with software (provided you have enough memory to begin with). For instance, AST Research's Advantage/2, Cumulus Corp.'s CuRAM, IDEAssociates' IDEAmax/MC, Quadram's QuadMEG PS/Q, STB Systems' RapidRAM2, and Tecmar's MicroRAM, all can be made compatible with LIM 4.0 by adding new software drivers. Current versions of these products ship with LIM 4.0 drivers.

All expanded memory products — EMS 3.2, EEMS, and LIM 4.0 alike — have been developed for the same underlying reason: the 8088 and 8086 microprocessors used in PCs and XTs are, compared with the latest chip designs, severely constrained in their memory-addressing abilities. Because these chips are endowed with but 20 address lines, they can directly manipulate only 1Mbyte of memory (that is, two to the twentieth power addresses). Without a clean room, precision tools and more patience than the most skilled surgeon, it's impossible to graft additional address lines onto a microprocessor.

Expanded memory simply sidesteps the address-line limitation. Using techniques termed paging and bank switching, it makes each existing address line handle more than a single byte of memory.

In bank switching, memory is divided into several banks, each of which is set up as if it were the normal memory assigned to the microprocessor. An electronic switch connects one of the banks at a time to the address lines of the microprocessor. The microprocessor can read and change only the bytes in the currently connected bank. That is,



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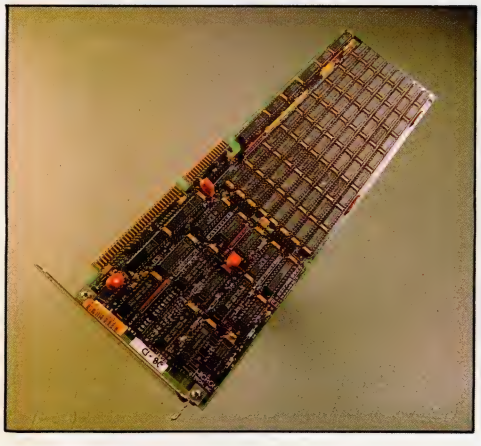
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each bank is a universe unto itself, completely independent of the rest, and can occupy the entire address range of the microprocessor.

Paging, a variation on the bank-switching technique, is used for all three types of expanded memory. Instead of connecting and disconnecting the memory spreading across the entire address range of the microprocessor, paging moves smaller blocks — a mere 16k in each under the expanded memory specifications — into and out of the microprocessor's memory realm.

Logistics are an important part of all expanded memory specifications. Two quantities must be defined to make the system work across all product lines. Some area within the microprocessor's address range must be given over as a paging area, where the memory swaps can be made. In addition, some means of controlling the switch must be standardised.

Under EMS 3.2, the normal 640k base-memory area used by DOS is deemed off-limits for paging, because in most PCs memory is directly connected to the microprocessor's address lines and cannot be switched around. Moreover, moving this memory could shock programs that might suddenly find a block of their code switched to never-never land. In addition, DOS memory is in short supply as it is; prising more bytes from its grasp would be counterproductive, particularly for people who try to load a dozen terminate-and-stay-resident utilities.

For all of these reasons, the original EMS 3.2 requisitioned an area above DOS memory but within the megabyte address range of the 8088 for its paging. Leafing through this stretch can be treacherous, however, because IBM reserved all memory between 640k and 1024k for specific purposes — video memory and BIOS, hard disk, and network ROM. Nevertheless, in most systems large blocks in this addressing range are unused. EMS 3.2 simply took over a 64k range for use in paging.

To control the paging into and out of this memory range, all the expanded memory specifications pass instructions through one of your system's I/O ports. Your computer's microprocessor need only send the page number it wants to the port controlled by the EMS board, and the appropriate page is switched into range. Programs that use EMS must, of course, know the correct port number to make use of expanded memory.

In addition to these facilities, the expanded memory specifications also provide your system with an extended



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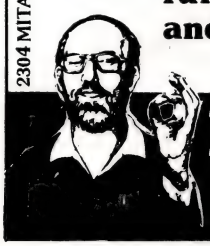
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- 6 - 10MHz switchable
- Hi-res mono screen
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set of commands for streamlining the use of the extra memory. The instructions are packaged as an expanded memory driver, software that's loaded into your system through its CONFIG.SYS file.

The more complex EEMS system allows greater versatility by moving 16k pages — up to 64 — in and out of the DOS area as well as the IBM reserved area. Control software that uses EEMS (for instance, Quarterdeck Software's DESQview) is charged with the responsibility of making sure programs have all their code available when they need it.

On pre-PS/2 hardware, giving EEMS control over DOS memory requires finding an unused memory area within DOS's 640k limit that can be used for paging. That means either not installing the full 640k quota in your PC or depopulating (prising chips off) your system board, which may waste memory that you've paid for. While the specification allows access to the full 1Mbyte addressing range of 8088 and 8086 microprocessors, in practice EEMS cannot manipulate all DOS memory in systems with hard-wired memory allocation because some RAM must remain conventionally connected to the microprocessor to allow it to boot up properly. According to most vendors of EEMS products, keeping 256k of conventional DOS memory allows optimal operation. (Note that EEMS is a superset of EMS 3.2 and will work exactly like it if no DOS-addressable memory is available to it.)

By moving to the DOS area and manipulating larger memory blocks, and providing additional software support, EEMS added an important ability to ordinary EMS: programs could run their code in the expanded memory area.

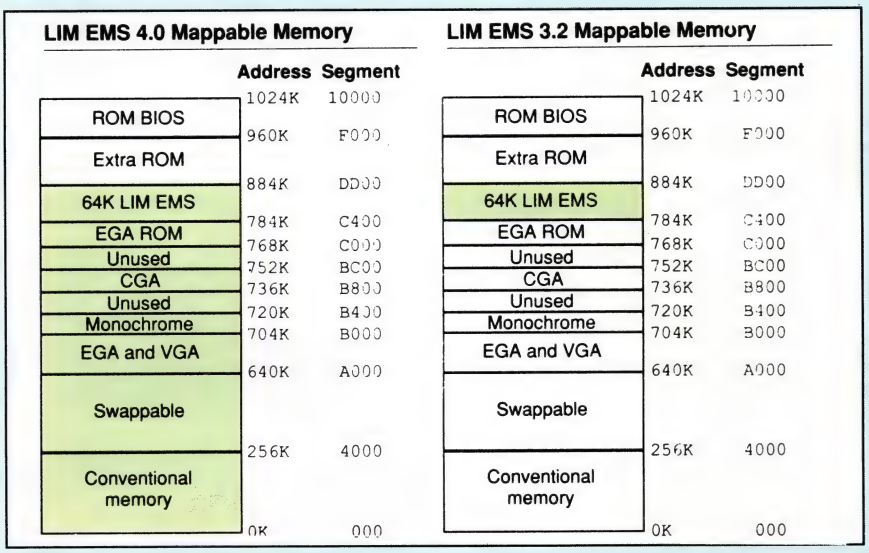
LIM 4.0 extrapolates further on EEMS, making both old EMS 3.2 and EEMS subsets of itself. It takes advantage of all the code-running and DOS-switching abilities of EEMS and adds the power to handle greater memory and greater support of multi-tasking. It allows programs to be written that can manage multi-tasking themselves instead of requiring the use of special operating environments (for instance, Microsoft Windows or DESQview). Programmers benefit from a doubling of the number of functions built into the specification that make taking full advantage of the expanded memory easier.

While EMS 3.2 allowed the addressing of no more than 2Mbytes per expansion slot, LIM 4.0 is virtually unlimited. Its quadrupled capacity (32Mbyte versus the 8Mbyte of EMS 3.2) even puts older 8088 microprocessors on a par with the abilities of the 80286 and 80386SX chips. In fact, the huge addressing range of LIM 4.0 also puts it way ahead of OS/2, which is currently restrained by the 16Mbyte limit of the 80286 chip. Only the 80386 can handle more RAM, and using it effectively requires exotic software indeed.

The LIM 4.0 memory advantage: bigger is better

These maps show the difference in the amount of mappable memory available under the EMS 3.2 specification and the LIM 4.0 specification. EMS 3.2 supplied 8Mbytes of memory beyond the 640k limit, while LIM 4.0 supplies up to 32Mbytes of memory above 640k. Both EMS 3.2 and LIM 4.0 call for addressing memory in page frames of 64k. As the tinted areas indicate, LIM 4.0 offers the ability to map any application that resides in memory from 0k to 884k, whereas EMS 3.2 offered only a 64k address range for expanded memory. (In both cases, areas above 884k are reserved for ROM). As a result, video driver routines, device drivers, network devices, and even LIM 4.0's Expanded Memory Manager drivers can take advantage of this enlarged addressing range.

As a practical matter, though, you will probably not want to use the areas already reserved for display ROM, COMMAND.COM, and the DOS work/system area.



The OS/2 question

Expanded memory and OS/2 mix about as well as oil and water. Although the two techniques for putting more memory at the beck and call of your programs are not mutually exclusive, the results of combining them are unlikely to be either pleasant or desirable.

Moreover, the pairing will probably be futile. Both require software that's written particularly to their individual standards. Since either standard brings your PC all the power that you're likely to need, bringing together two levels of complication for no additional benefit makes little sense. Either standard lets you break the DOS 640k addressing barrier. Each, however, offers its own individual benefits.

Expanded memory gives you the advantage of having a base of software that's available now. All existing LIM 3.2 and EEMS programs will run under the LIM 4.0 standard. In addition, LIM 4.0 will enable big applications to run on 8088 and 8086-based computers, while OS/2 requires at least an 80286 microprocessor. LIM 4.0 also can add its power to other PCs for which compatible versions of OS/2 are not available. (OS/2 is very hardware-specific, and nearly every manufacturer's computers require their own version of the operating system). In other words, today LIM 4.0 allows you a wider selection of programs and platforms. While OS/2 does let you run existing DOS programs, it forces you to execute them in its performance-robbing compatibility box. While you can get by doing that, you won't want to use the compatibility box for running your most important, everyday applications.

The real role of OS/2, as writers have been saying for the past year and a half,



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lies in the future. Someday — perhaps soon — you may run into the perfect program, one that does everything that you've only dreamed was possible before, including multi-tasking and handling data elements of multiple megabytes, and that takes advantage of all the programmers' hooks, lines and sinkers built into OS/2. When you find that program, you'll finally be forced to use OS/2.

While you probably won't want to move your EMS software to the OS/2 environment, the good news is that you should be able to move these memory boards into the OS/2 operation with, at most, a DIP switch change. In other words, should you decide to make the move to OS/2, you won't have wasted money buying a LIM 4.0 board.

LIM 4.0 boards designed for ATs make the transition easily because they uniformly allow the allocation of their memory between the extended and expanded addressing ranges, and that allocation is hardware mediated. In most cases the only change you'll have to make is resetting switches or running a setup program.

The software that's used to set up some of these AT-style LIM 4.0 boards poses more perplexing problems. In some cases you may not be able to use it at all. For instance, you cannot run AST's extended-memory software emulator because you can't use their expanded-memory driver under OS/2. However, AST also allows the assignment of its memory to the extended area through hardware, so the board itself will work with OS/2.

Products that use DOS software only for setup are merely bothersome under OS/2. Because their setup procedure merely pushes values into memory registers rather than running in the background, it can be run through the compatibility box.

Because the PS/2 and OS/2 were made for each other, you'd think that problems mating the two would be nonexistent and that memory boards designed for PS/2s will work perfectly under OS/2. For up to 2Mbytes, that's true. No PS/2 memory board should have difficulties.

However, beyond 2Mbytes you can encounter problems. Initially, all memory boards stretching beyond that limit would not work with OS/2. The trouble — a PS/2 design faux pas — was located earlier this year, and IBM worked with memory board manufacturers to ensure the compatibility of their products. That's one reason that Orchid's RamQuest Extra has its own on-board BIOS. Both of the PS/2 products subject to review here were tested and found to function with both OS/2 and LIM 4.0.

While applications that run in OS/2's extended mode are as scarce as honest politicians, the number of expanded mode programs is impressive and growing, with new versions of Microsoft Windows and Lotus 1-2-3 being of particular interest. The recent revision to the Lotus/Intel/Microsoft expanded memory specification, from version 3.2 to 4.0, promises that more and better tools will soon be in your hands. The memory boards examined here will put LIM 4.0 power into your PC today — and give you the memory you need for OS/2 whenever you decide to make the move.

PC and AT-bus compatible

Advantage Premium Rampage 286

AST Research offers two different LIM 4.0 solutions for PC and AT-bus computers. The Rampage 286 furnishes 16-bit memory, and the Advantage Premium packs a plethora of ports along with its 16-bit RAM supply. Both are products that have been upgraded from the earlier EEMS specification with new LIM 4.0 software. AST's Rampage 286 relies on DIP switches to assign its memory to the DOS addressing range, set the expanded memory base I/O address and control other functions. A second switch bank allows setting total memory size so that you can cram up to four Rampage 286 boards in a single system (giving you a maximum endowment of

At a glance

Advantage Premium
Supplier: Imagineering
Tel: (02) 697 8666
Price: with 512k, $975; with 1Mbyte, $1497, game port, $85.
Requires: IBM PC or compatible.
Rampage 286
Supplier: Imagineering
Tel: (02) 697 8666
Price: with 512k, $1235; with 2Mbytes, $2800.
Requires: IBM PC AT or compatible.
In Short: The Advantage Premium is a 16-bit memory board with two serial, one parallel, and one game port that's set up through DIP switches to add 1Mbyte to ATs or 2Mbytes with optional daughterboard. Can be combined with several Rampage 286 boards for up to 8Mbytes per system. The Rampage 286 is a 16-bit LIM 4.0 — compatible memory board that adds up to 2Mbytes. It is set up using DIP switches. Up to four boards can be added to a system for 8Mbytes expansion.

LIM-ulators: the next best thing to hardware

You can let your PC take advantage of expanded memory without buying an expensive LIM 4.0 board.

LIM-ulators are software-only products that emulate the operation of expanded memory boards. Simply by adding the appropriate entry to your system's CONFIG.SYS file and LIM-ulator software, you can add expanded memory to your system, drawn either from the extended addressing area or from the hard disk using virtual memory techniques. The complete LIM 4.0 specification cannot be simulated, however. Both the developers of LIM 4.0 (in particular, Lotus) and the creators of LIM-ulators agree that some of the hardware features of the new specification cannot be duplicated through software alone.

The chief impediment arises in an esoteric area. "EMS 3.2 left ambiguous whether the same page can be mapped at two different addresses," explained Rocke Versar, principal of Fort's Software, publisher of *V-EMM*, a software-only LIM 4.0 emulator. "Version 4.0 defines how such a mapping must work in a way that is totally impossible to do only with software." Currently, few programs do such double-mapping, so most LIM 4.0 programs will work with software-only emulators written to simulate all other aspects of the specification.

At the time of this writing, only Fort's Software offered a software-only LIM 4.0 emulator. Current versions of *V-EMM* include individual drivers that follow the EMS 3.2 and LIM 4.0 specifications. Because of the complexity of the new specification and its added memory requirements, the company recommends using the EMS 3.2 emulator whenever possible; the LIM 4.0 emulator only when absolutely necessary.



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Performance tests: LIM 4.0 Boards

APC tested four PC and AT-compatible LIM 4.0 boards using an 8MHz IBM PC AT with a 30Mbyte hard disk and three Micro Channel PS/2-compatible boards using a 10MHz IBM PS/2 Model 60 with 1Mbyte of system memory. Test results were normalised against Intel's Above Board PS/286 for the PC and AT-class boards, and Intel's Above Board 2 for the PS/2-compatible boards.

The great difference in performance between the fastest and slowest boards was mainly due to the presence of extra hardware registers. If extra registers are not present, they must be emulated by the software. This may slow the processing of certain functions. In some cases, however, especially efficient LIM 4.0 software may make up for the absence of extra hardware registers.

The fastest PC and AT-compatible LIM 4.0 boards were AST's Advantage Premium and Rampage 286, and Micron Technology's Micron Memory Board. Of these three, the AST boards came equipped with extra hardware registers. The Micron Memory Board turned in very fast times without extra registers because its software takes advantage of whole word moves, not just byte moves.

Among the PS/2-compatible LIM 4.0 boards, Orchid's RamQuest II and RamQuest Extra were considerably faster than Intel's Above Board 2. The Orchid boards employ TRAM, or translation RAM, a Micro Channel architecture function that allows quick memory swaps with low overhead. Conventional software memory moves require that a string/move function be performed to swap memory addresses. With TRAM, as implemented by Orchid, a dynamic swap may be made with very little overhead, resulting in the kind of speed that these boards yielded in our tests.

We installed the boards using the default mode for most and selecting zero wait states when possible. Note that running a board at zero wait states depends upon your computer's clock speed and the memory chip speed of the board. This is explained fully in the documentation that accompanies each board.

The LIM 4.0 specification is implemented through a combination of hardware, in the form of an expanded memory adaptor board, and software, in the form of the EMM, or Expanded Memory Manager. The EMM is a DOS device driver that controls and manages access to and allocation of expanded memory. It supplies a number of services that an application can call upon in order to use expanded memory.

One of the services that the EMM offers is the Move Memory Region function. By requesting that this service be performed by the EMM, an application can use this function to move a block of data without changing the current memory map. The EMM then takes over and does the actual work of moving the block of data.

The 'Move Test' measures how long it takes a board's implementation of the EMM to move a 256k block of data using the Move Memory Region function. The test is performed twice, once using small records and once using large records. The small-record test uses 64-byte records and indicates the amount of function call overhead incurred, since the 64-byte move is performed 4000 times in order to move the entire 256k block.

The large-record test uses 128k records and thus is a measure of the speed at which the EMM can move large multi-segment blocks of data. In this case, less overhead is incurred because the 256k block is moved in two pieces.

The data is moved from expanded memory to conventional memory, conventional to conventional, conventional to expanded, and expanded to expanded memory. For 64-byte records, moves from conventional to conventional should be the fastest because the EMM does not have to save the current mapping context (conventional memory does not need to be mapped as expanded does). Conversely, 64-byte record moves from expanded to expanded should take the longest, since the current mapping context must be saved and restored. This difference is less apparent for 128k records, which are moved only twice.

Expanded memory adaptors that are equipped with extra hardware registers have a performance advantage here because the mapping context can be saved and restored from these registers.

PC- and AT-Bus Compatible

	Move Test 128k records				64-byte records			
PerformanceTimes (Times given in seconds)	Expanded to conventional	Conventional to conventional	Conventional to expanded	Expanded to expanded	Expanded to conventional	Conventional to conventional	Conventional to expanded	Expanded to expanded
Above Board PS/286	4.45	4.45	4.45	4.45	5.89	5.30	5.87	6.04
Advantage Premium	0.27	0.10	0.25	0.43	2.14	1.77	2.14	2.67
Rampage 286	0.25	0.10	0.27	0.40	2.14	1.79	2.14	2.65
Micron Memory Board	0.10	0.05	0.05	0.10	2.63	2.41	2.65	3.40
Micro Channel PS/2 Compatible								
Above Board 2	2.96	3.02	3.00	2.98	4.15	3.57	4.17	4.28
RamQuest II	0.08	0.05	0.07	0.10	1.50	1.31	1.53	1.84
RamQuest Extra	0.07	0.08	0.07	0.08	1.55	1.33	1.57	1.86

8Mbytes). You can also defeat parity checking by setting another switch.

The Rampage 286 includes setup software to allocate memory in the expanded range and add entries to your system's CONFIG.SYS file for utility programs. (It will also set up emulated extended memory for use by the AST utilities that may require it).

The full-length, XT-height Rampage 286 board holds 72 sockets physically arranged in eight banks, logically in four. The board is compatible only with 256k memory chips rated at 120 nanoseconds or better; this allows it to be used in

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computers with bus speeds of 8MHz or less, including ATs and the XT Model 286. Because memory must be added 18 chips at a time, possible board capacities include 512k, 1Mbyte, 1.5Mbytes, and 2Mbytes.

The Advantage Premium adds up to two serial, one parallel, and one game port to the capabilities of the Rampage 286. However, its fundamental design is quite different. The board itself holds only 1Mbyte divided among 36 sockets for 256kbit DRAM chips. A second megabyte, comprising thirty-six 256kbit chips soldered to a daughterboard, extends single-slot capacity to 2Mbytes. The extra ports of the Advantage Premium consume additional glass-epoxy real estate so much that the full-length board fits only in AT-height computers. Although you'll want to put only a single Advantage Premium in your computer (otherwise you'd waste ports), you can combine one with up to three Rampage 286 boards.

Besides the memory configuration switches like those used on the Rampage 286, the three DIP-switch banks of the Advantage Premium allow you to selectively enable its ports. A bevy of on-board jumpers allows you to select which serial lines you want active. Software setup for the LIM 4.0 driver and AST's utility software is included.

The connectors used by the Advantage's ports follow the AT standard: serial ports use male 9-pin D-shell connectors; parallel ports use 25-pin female connectors. The optional game port and second serial port come with cables and connectors that attach to on-board headers. Both serial ports use a 16450 UART (Universal Asynchronous Receiver/Transmitter) chip, same as the AT.

All three boards share the same Super-Pak of utilities (disk emulator, print spooler and others), design quality, workmanship, and LIM 4.0 driver. All but the last are up to (or even set) today's industry standards. In the 128k and 64-byte Move Tests, the boards turned in very respectable results. Choose these boards for their full LIM 4.0 support, good performance, and quality — not for price.

Above Board PS/286

If there were an award for the most misleading product name, Intel's Above Board PS/286 would be a prime contender. The board is not meant for the IBM PS/2 series of computers, nor is it restricted for use with machines based on the 80286 microprocessor.

The former part of the moniker can be explained — the 'PS' stands for 'Parallel and Serial' ports, with which the board comes equipped. A similar product without ports is dubbed merely the Above Board 286. While, in truth, either will work with 80286 computers, these memory/multifunction boards can also endow the PC and its 8088 or 8086-based kin with expanded memory.

The basic board runs the full length of any XT-height expansion slot. Although it is equipped with an AT-style 16-bit edge-connector, Intel provides a simple jumper that converts the board to 8-bit operation, the extra connections dangling outside the host machine's bus connector.

The RAM on the Above Board — eight socketed nine-chip banks stuffed cheek-to-jowl with virtually no space in between — can be assigned to any standard memory class: conventional, expanded, or extended. Of course, extended operation is not possible in 8088 machines, which cannot address RAM above 1Mbyte.

The Above Board itself holds 2Mbytes of 256kbit DRAM chips. A piggyback memory daughterboard pushes the possibilities to 4Mbytes. At minimum, two nine-chip banks — 512k RAM — must be installed. Adding more chips permits any 512k increment between that minimum and the board's 2Mbytes maximum.

Intel rates the Above Board for use in 80286-based computers operating as fast as 12.5MHz. In 8088-based computers, the speed limit is 8MHz. For operation at speeds above 10MHz, Intel recommends using chips rated at 120ns or faster. The review sample arrived equipped with 70 chips rated at 120ns and two at 150ns. Evidently, you can mix chip types as you please — at least Intel does.

All in a day's work

LIM 4.0 performance tests are as useful as debuggers as they are instruments of measurement.

Why would five memory boards that passed the LIM 3.2 benchmark tests — and work fine with applications that support LIM 4.0 — fail our new suite of LIM 4.0 performance tests? That was the unexpected question we had to answer after only Intel's Above Board PS/286 and Above Board 2 turned in satisfactory results on our tests.

The LIM 4.0 performance tests don't attempt to simulate the activity of a real-world application. Instead, they start with a set pattern in the physical and logical memory pages, set up each LIM function, call the LIM Expanded Memory Manager device driver, and test the results for validity. Apparently, some applications that support LIM 4.0 do not make use of all of the specification's functions. It was when we tested the boards' ability to address those functions that they failed. The bottom line: testing boards with commercial applications is no substitute for a rigorous test based on the specification itself.

The major failures we found were in function 22 (Alter Page Map and Jump) and function 23 (Alter Page Map and Call). These functions enable program code to be executed in LIM memory, a technique that is not currently in wide-spread use. In the future, however, this programming method could be used to place the bulk of a terminate-and-stay-resident (TSR) program in LIM memory, thereby freeing up much-needed DOS memory. The errors we encountered while testing these functions ranged from corrupting the Flags register — a minor offence — to crashing the system.

Upon finding these problems, we contacted each manufacturer's technical support staff. Any doubts we had about the validity of the test results vanished as each manufacturer's sent us an updated Expanded Memory Manager that we could retest. These new versions passed all of the tests and will soon be shipped with the boards. If you already own one of these boards, simply contact the vendor to obtain a software upgrade.

S Greenberg

At a glance

Above Board PS/286
Supplier: Tech Pacific
Tel: (02) 662 1080
Price: With 512k, $1390; daughterboard with 512k, $1488; second serial port, $118.
Requires: IBM PC, PC-XT, PC AT or compatible, or IBM PS/2 Model 30.
In Short: The Above Board PS/286 features LIM 4.0 support and works in both 8 and 16-bit computers. Parallel and serial ports are standard.

The Intel Above Board PS/286 turned in the slowest results on both of the Move Tests. Similarly, the Above Board 2, which is designed for the PS/2 line, was considerably slower than its competition in that product category.

As with most of today's state-of-the-art enhancement products, the Above Board has no switches or jumpers for setup. Instead, you run a menu-driven installation program called 'Setboard', which assigns memory types, sets base and I/O addresses for expanded memory, and sets up the serial and parallel ports. A second program, 'Install', handles the software part of installation, adding entries to your AUTOEXEC.BAT and CONFIG.SYS files to set up the print buffer, RAMdisk, and expanded memory. It even copies the Intel software to your hard disk.

The serial and parallel ports follow AT practice. The serial port is equipped with a male 9-pin D-shell connector on the card-retaining bracket. The 25-pin female D-shell connector of the parallel port is just below.

The second serial port is available only as a header on the card itself and requires an adaptor and connector. Adding the second port also requires a second UART (Universal Asynchronous Receiver/Transmitter) chip.

The design and manufacturing quality of the Singapore-made board are beyond reproach. The documentation is also very good, divided into sections for beginner and expert levels.

Although the Above Board PS/286 is a software upgrade of Intel's EMS 3.2 product, it is fully compatible with the LIM 4.0 specification. In fact, both the Above Board PS/286 and Above Board 2 were the only products of this group that, on the first try, did not fail to perform any of the functions we tested. If you can live with the board's slow performance, you can count on its conforming to the LIM 4.0 spec.

At a glance

Micron Memory Board
Supplier: Eastern Micro Electronics
Tel: (03) 699 3088
Price: With 1Mbyte, $1056; with 2Mbytes, $1728; with 4Mbytes, $3348.
Requires: IBM PC AT, or 16-bit compatible.
In Short: A memory-only board that packs up to 2Mbytes (four with optional daughterboard) of 16-bit memory into a full-length, XT-size slot.

Micron Memory Board

Micron Technology is America's premier memory maker, the only US company that still makes virtually nothing but DRAM. The memory-only Micron Memory Board is exactly the kind of product you'd expect from Micron's systems division: simply a vehicle for putting its chips to work in an AT expansion slot.

Micron is so intent on selling you its chips that you can't buy the board by itself.

It's only available equipped with factory-supplied chips. You can add a daughterboard and stretch the price and capacity to $3348 for 4Mbytes.

In any of its incarnations, the Memory Board will support the LIM 4.0 spec as well as its included EMS 3.2 and EEMS standards. The board can also backfill conventional memory from 256k or 512k, up to 640k, and divide its remaining capacity between extended and expanded memory in any way you want.

The Memory Board is a full-length, XT-height card made to fit low-rise machines. It's made to use only 25- kbit chips, and in 2Mbyte dress (as the review unit was received) all memory chips are soldered. The 1Mbyte version has four nine-chip banks soldered to the board and provides an equal number of sockets for expansion. Micron supports the installation solely of its own 256k DRAM products in these sockets (although other makers' chips will work). A piggyback board can add two more megabytes of extended memory to the EMS board. All memory is parity-checked.

Micron rates its EMS board's speed at 8MHz with zero wait states or 12MHz with one. Zero-wait-state operation can be defeated by software command during setup. On the 128k Move Test, the Memory Board was one of the fastest performers. However, on the 64-byte test the board dropped back to the midrange.

As with PS/2s, all operating parameters of the Memory Board are set through software, in this case using Micron's own program. Menu-driven, it allows fast and convenient selection of the frame and I/O addresses used by the board, oversees the functional division of its capacity, and handles testing. As with PS/2s, bad memory areas on the Memory Board can be mapped out of use, and parity checking can be disabled. Micron also includes three EMS drivers (one each for the major specs — EMS 3.2, LIM 4.0, and EEMS), a RAMdisk, and a printer spooler.

The software we tested, version B4.1, failed to perform two LIM 4.0 functions and caused the system to crash when it tried to accomplish 128k moves. After we called Micron, the vendor sent new, improved software, version B4.2. The new version should be available by the end of the year.

The documentation offers an unusually good explanation of the various types of memory used in IBM computer systems. Other than its resemblance to the printship work of a high school vocational-education class, the manual rates as quite good overall. Workmanship on the board itself is as good as any, and better than most.

The strong point of the Micron Memory Board is its configuration flexibility; its weak point, the limited chip and capacity choices. If you don't mind dealing in megabyte increments, you'll find the Micron Memory Board a useful choice.

At a glance

Above Board 2
Supplier: Tech Pacific
Tel: (02) 662 1080
Price: with 512k, $1488;with 2Mbytes, $3908.
Requires: IBM PS/2 Model 50 or 60.
In Short: A Micro Channel memory expansion board that adds up to 2Mbytes of 16-bit DRAM and includes full LIM 4.0 support.

Micro Channel PS/2 Compatible

Above Board 2

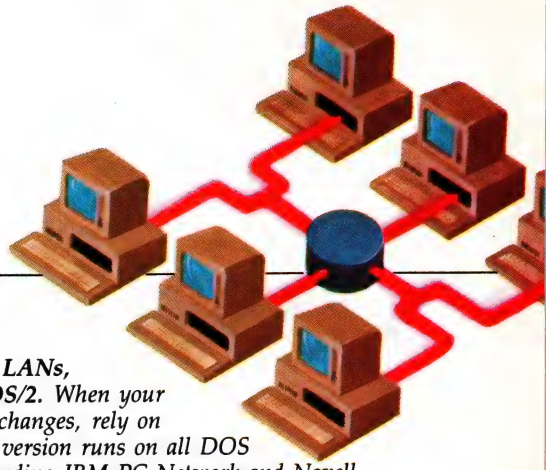
From the company that was one of the inventors of the EMS standard, you should expect an inventive product. Instead, the Intel Above Board 2 is slightly quirky and a bit of a throwback, although it's entirely workable as a memory enhancement for your PS/2 Model 50 or 60.

The Above Board 2 is fundamentally a platform for 2Mbytes of memory. It contains eight sockets for 256k SIMMs. Because of the 16-bit nature of the Models 50 and 60, SIMMs must be added in pairs. This arrangement allows Above Board capacities from 512k to 2Mbytes in 512k increments. The board cannot use 1Mbyte SIMMs.

Unlike more-conventional products and somewhat at odds with the PS/2 philosophy, the Above Board 2 requires you to set on-board DIP switches to reflect the number of SIMMs installed. After you do that, hardware installation is much like that of any other PS/2 add-in.

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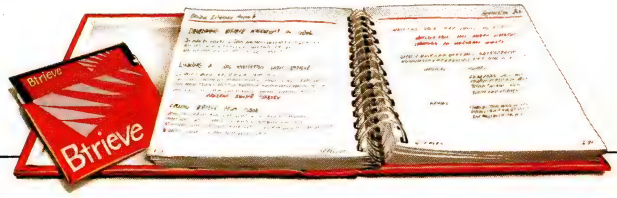


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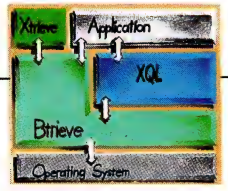


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Just run the setup procedure on your system Reference Disk.

Once the hardware is installed, you can bring the EMS memory to life by running Intel's setup program, SoftSet. The menu-driven software automatically copies the Intel support programs to your hard disk and gives you menu-driven control over setting up EMS, a printer spooler, and one or two RAMdisks.

Intel allows one other option. You can substitute 1Mbyte of the RAM on the Above Board 2 for the planar board memory in your PS/2. Ordinarily that would not confer a big benefit. However, when the Above Board 2 is loaded with 100ns SIMMs, it can run without wait states, accelerating your PS/2 by 20 per cent or more. Intel also includes another DIP switch for no-wait-state operation.

The Above Board 2 is well made, although it uses conventional pin-in-hole rather than surface-mount technology. The board is dominated by two Intel custom VLSI chips.

Documentation is clearly written and cleverly subdivided into sections for inexperienced and expert users, expert apparently meaning that you've peeked inside your computer before. Lacking are explanations of the options with which the SoftSet program automatically fills your AUTOEXEC.BAT and CONFIG.SYS files.

The Above Board 2 will undoubtedly work well in your PS/2. Like the Intel Above Board PS/286, it was the only board that correctly performed all the functions we tested for, right out of the box. Its only shortcomings are philosophical misunderstandings (or underappreciations) and its slow performance — it was the slowest of the three PS/2-compatible boards we tested. If you can live with those, you can make good use of the Above Board 2.

RamQuest II, RamQuest Extra

The first to introduce an aftermarket memory expansion board for the Micro Channel, Orchid Technology has been steadily improving and upgrading its product line for PS/2s. The RamQuest II and RamQuest Extra represent the most recent incarnations of those development efforts.

Although both are memory boards for the Micro Channel, the two products use different approaches and technologies to achieve their goals.

The chief functional distinction between the twain is that the RamQuest II is more a meat-and-potatoes product, a straight memory add-in with a capacity limit of 2Mbytes. Both products can be used in any Micro Channel PS/2, from the Model 50 through to the Model 80, although their 16-bit interfaces may hold back system performance in the 32-bit Models 70 and 80. Technically, however, they are as different as night and day.

The RamQuest II starts with a base of 1Mbyte of soldered memory in one big, 36-chip bank of 256-kbit zigzag in-line integrated circuits. Two 18-chip banks of sockets are also available for holding more conventional dual in-line packages one by 256-kbit memory chips. If you want to add your own chips to the board, Orchid suggests that they be 120ns or better.

Notwithstanding the switchless philosophy of the Micro Channel, the RamQuest II includes three jumpers that you must set to reflect the number of banks of memory to be used on the board. Otherwise, installation is simply a matter of plugging in the board and running normal IBM setup procedures using your Reference Diskette.

The Micro Channel interface is handled by a single VLSI chip and an Orchid proprietary PAL. Otherwise, the board is completely constructed from soldered lead-in-hole logic chips. Manufacturing quality rates with the best, and the boards are sure to stand out in your PS/2 with their oddly coloured plastic guides — orchid, rather than blue.

The RamQuest Extra fits more with the feel of the Micro Channel. It mixes both lead-in-hole and surface-mount technologies and requires no physical setup of the hardware; its one jumper is for factory testing. It incorporates its own on-board BIOS to ensure full operating system compatibility (including OS/2 support).

The board contains eight sockets for SIMMs, logically grouped in pairs. As long as a pair of sockets is filled with the same size SIMMs, you can mix either 256k or 1Mbyte modules on the board. The RamQuest Extra is smart enough to sort out whatever you do; it will even fill non-adjacent banks.

The minimum factory configuration is zero memory. According to the documentation, the only other factory option is 512k. Orchid includes clear instructions for adding more SIMMs, but the only guidance it offers for selecting the proper modules is a required speed rating of 120ns. Orchid does not supply a list of compatible parts.

The two serial ports are based on the same 16550 UART chips as are IBM's PS/2 serial ports. For space reasons, however, the port connectors follow the 9-pin male D-shell connector standard used by the AT, instead of that of PS/2s.

The RamQuest Extra is as colourful as the RamQuest II, but it's not quite as well made. Several jumper wires that adorned the rear of the board we evaluated looked as if they were grafted into place by a five-year-old with a wood-burning set. In addition, the multitude of ICs on the board also included one 8-pin mystery chip, its identification sanded off apparently for some security reason.

Both Orchid products were accompanied by the same complement of software: a RAMdisk program, a printer utility program that included spooling, and installation programs for this software. They turned in almost identical performance on both Move Tests, and overall yielded the fastest results.

The installation procedure for both boards was nicely integrated into the PS/2 setup. The RamQuest Extra proved troublesome in installation, however. Unless you follow the instructions to the letter — including copying the necessary ADF file to your Reference Disk before physically installing the board — you will be doomed to failure. Other PS/2 products are not so fussy. According to Orchid, the strict installation order is necessitated by the on-board BIOS.

Documentation is exemplary, lacking only a list of compatible memory chips. The automatic installation procedures are complemented by a listing of options that let you make adjustments by using a text editor rather than the installation program.

While the RamQuest II earns a hearty recommendation as it stands, the RamQuest Extra could use a more forgiving installation procedure and some refinement in its construction.

END

At a glance

RamQuest
Supplier: Porchester Computers
Tel: (03) 537 2722
Price: RamQuest II, with 1Mbyte, $1550; RamQuest Extra, with 1Mbyte, $2615; with 2Mbyte, $2915.
Requires: RamQuest II, PS/2 Model 50 or 60; RamQuest Extra, PS/2 Model 50, 60 or 80.
In Short: The RamQuest II is a LIM 4.0-compatible memory expansion board for PS/2s that puts up to 2Mbytes in a single slot. The RamQuest Extra is a LIM 4.0-compatible memory expansion board for Micro Channel PS/2s that adds up to 8Mbytes along with two serial ports. Built-in BIOS assures OS/2 compatibility, but the board's installation procedure is a bit finicky.

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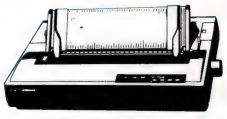
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Linus Write-Top

A recurring dream of computer scientists and science fiction writers has been the computer that can read people's handwriting. The Write-Top from US firm Linus Technologies, appears to have achieved this goal . . . but when computers get involved, there is more to writing the old-fashioned way than meets the eye, as Owen Linderholm discovered.

Recognising and understanding handwriting is one of the grails of the computer industry. Every now and again someone seems to have a promising method, but in practice it never works out. The technology required to recognise handwriting has slowly become more practical, especially with the advent of cheap scanners for desktop publishing. There are now many software packages that can perform optical character recognition (OCR) and some can do it for practically any kind of printed type.

Printed type is the key. No-one has yet come up with a scanner that can recognise handwritten characters, although a few manufacturers have been making wild claims about recognising block lettering.

So, it came as a surprise when the Linus Write-Top was announced. Not only can the Write-Top recognise handwriting, but it doesn't have to scan it in. You write directly on to an electronic 'sheet of paper', which also happens to be the screen. The Linus Write-Top heralds a completely new approach to data entry for computers. It is now possible to envisage the availability of a computer system in the near future which you write on as if it were a piece of paper — except that you will be able to edit and modify what you have done easily and quickly. You will be able to



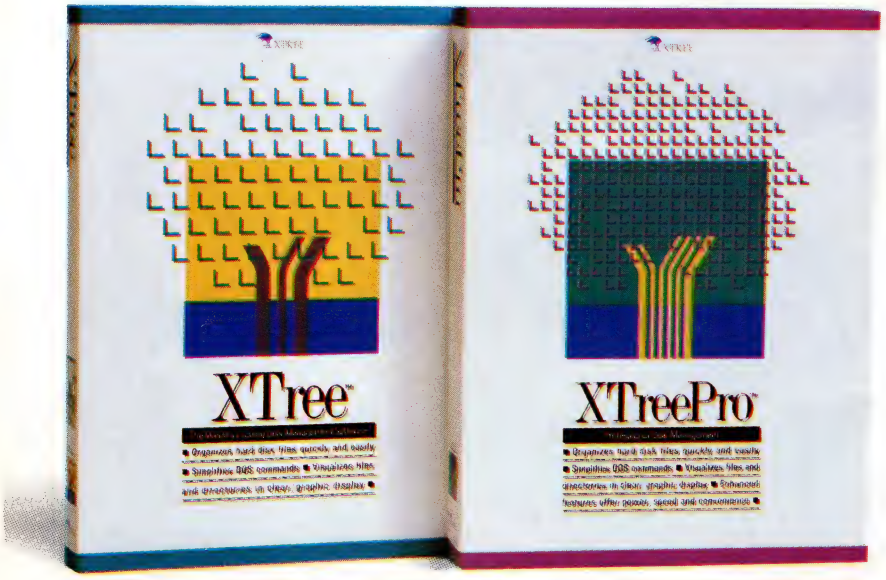
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combine text, drawings, sketches, tables, forms and pretty much anything else.

Hardware

The Linus Write-Top is basically a standard IBM-compatible laptop computer. It uses an ordinary NEC V20 processor, which is an 8088 equivalent clocked at 7.16MHz. The display is a supertwist LCD with electro-luminescent backlighting and displays 640 by 200 pixels. There is a built-in 3.5in floppy drive.

It has a single AT-style 9-pin serial port and a standard parallel printer port. Apart from the ability to take an optional Hayes-compatible 300 and 1200 baud modem and a rechargeable battery pack, the only remaining similarity to a normal laptop is that it weighs 4kg overall.

In fact, the difference between the Linus Write-Top and other laptops is obvious from the start — the Write-Top looks nothing like a laptop. It looks like an oversized grey sandwich with a big lump of cheese in the middle (rather than a slice). I doubt whether many people would recognise it as a computer. The casing is made of tough grey polycarbonate and is pretty robust, but dropping the machine is not recommended.

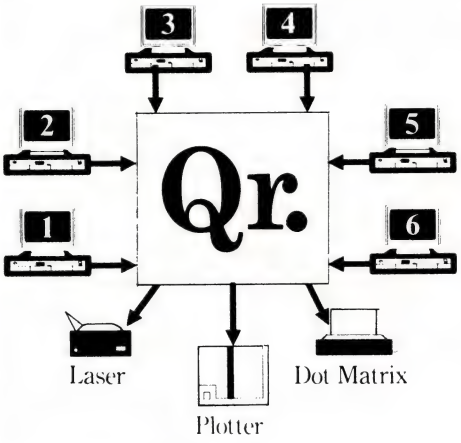
When closed, the machine is almost featureless. The only things visible from the front are a lift-up flap covered in little ridged bobbles on the top, the Linus logo, and a couple of ridged latches on the front. Recessed on the right-hand side is a reset button. At the back is a short loop of cable which leads into the 'filling' at the back. If you follow the cable the other way, you discover it snugged into a recess all the way around the inside of the underside of the top 'slice'.

At the back is a small hole for the power supply and a little notch in the bottom 'slice', just as if someone had taken a small bite from the bread of the sandwich. Inside the notch is a slot for plug-in memory cards, disappearing into the bowels of the machine. Finally, on the left-hand side is a carrying handle and a large, recessed button for turning the computer on and off (actually putting it to 'sleep' since memory contents are preserved until the battery runs out). The only writing on the case is the word 'Linus' and a small logo on the top at the front left.

Under the flap is the display, covered by a sheet of coated glass. A grey area below the display is also covered by the glass and has little indicator lights in the bottom left and right corners. In the hinge of the flap is the writing stylus which is attached to the display by a two-foot cable.

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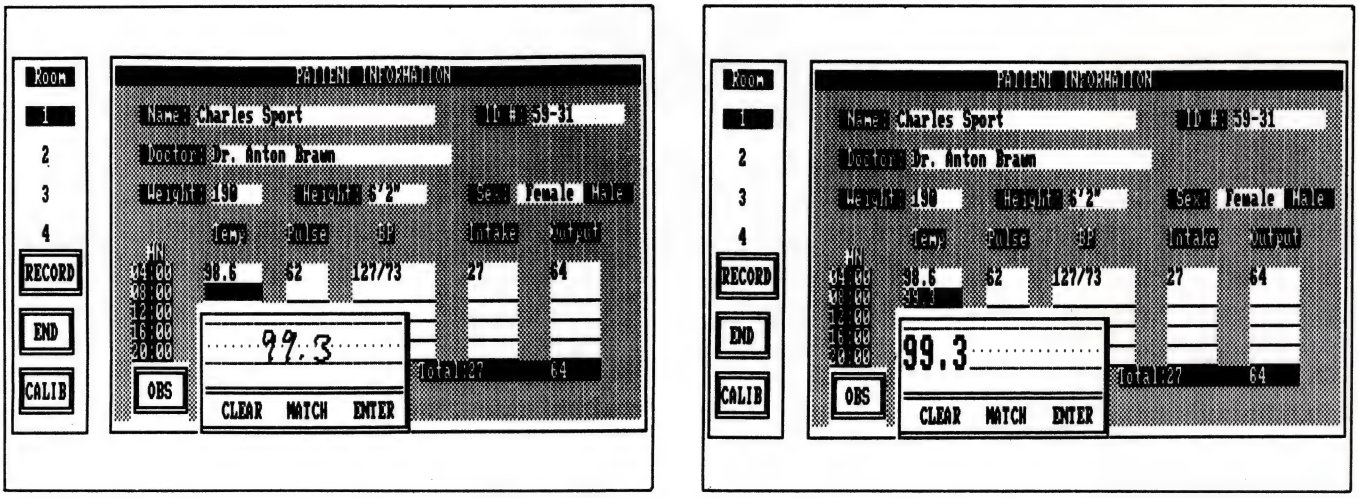
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A data entry panel is opened over a patient records system. The user writes in the patient's temperature and presses 'Match'. The system then displays the data as screen characters for confirmation. If you are confident, you can press 'Enter' and the data is entered into the application directly, as here

Unclick the latches at the front and the whole top 'slice' of the sandwich lifts away. The latches are very tough and a little difficult to undo, but they hold the whole thing firmly together for carrying. The recessed cable turns out to connect the top section to the rest of the unit and it is about three feet long.

The whole computer is 28cm square and 9cm high. The Note Pad section when separated is 28cm square and about 3cm thick.

The top section, the said Note Pad, combines the display and data entry mechanism and weighs about 1.3kg. The glass plate has a conductive coating across which a voltage is passed: the stylus is in fact a voltage probe. A particular voltage correlates to a particular position on the glass plate, so the Write-Top can detect where the stylus is pointing.

The stylus is very like a modified propelling pencil where a click on the button extrudes a fine lead a couple of millimetres, but instead of graphite, the stylus has a blunted metal point. However, you can remove this and replace it with an ordinary lead, and the stylus still works since graphite is electrically conductive. This means that you can use the stylus as an ordinary pencil as well if you have to make real written notes.

The rest of the Linus Write-Top is called the base unit. It has little rubber feet to hold it steady (as does the Note Pad) and besides the ports already mentioned, it has a switch to turn the backlight on and off as well as to click panels open. Behind one of these is the 3.5in disk drive. Behind the other are the I/O sockets. Apart from the ports already mentioned, there is a socket to take a standard XT-compatible keyboard and a 37-pin D connector for an external floppy drive, which can be either 5.25in or 3.5in.

The base unit has various little depressions into which small latches from the Note Pad rest flat on top of the base unit, or lets it rest at a convenient writing angle in different ways. In addition, the base unit can be wall-mounted, leaving the Note Pad separate as the only part of the computer to take up space on a desk.

An ingeniously designed carrying case helps when the Write-Top is used in the field. It can be carried like a briefcase, slung over a shoulder, slung over both shoulders, or even set up to be carried like a rucksack. In all cases, the Note Pad section can be carried separately at the front for use while walking about. Additionally, the whole unit can be slung so that the Write-Top is carried in front like a small table, similar to the trays ushers used to sell ice cream from during the adverts at the cinema. A panel of the carrying case swings open to give immediate access to the Note Pad in this position.

Other differences from ordinary laptops include the use of CMOS static RAM which is preserved by the battery when the machine is not in use. In addition, battery-backed, plug-in, credit card sized memory cards can be used. Only 512k cards are available at the moment, but 2Mbyte cards are planned, and so are ROM cards to hold application software.

User interface

The really interesting part of the Write-Top is the way the display and stylus recognition works in conjunction with the software. There are several sections to this. The two major ones are: recognising writing on the screen, and analysing and recognising handwriting from what has been written.

The basic technique for writing on the screen is that a varied voltage is applied horizontally and vertically across its glass plate covering. When the stylus touches the screen, it picks up a voltage which can be interpreted as a position on the screen. However, the probe and screen first have to be calibrated.

This is done by a short program which is run when the computer is first turned on. The user is asked to touch the stylus to two crosses that appear in opposite corners of the screen. From the readings obtained, the Write-Top can tell which voltages correspond to which points on the screen. The resolution of the stylus and voltage detector is four times the resolution of the screen display, and the voltage detection spreads over a larger area, so the position of the stylus can be resolved down to somewhere on a grid of approximately 2560 by 1067 points.

When the computer has recognised that the stylus has been touched to a particular position, it can perform some action. This is where the user interface of the Linus Write-Top comes in. There are two major modes of operation. One is pressing buttons, and manipulating menus and windows; the other is handwriting and sketching.

Out of necessity, the Write-Top package includes an extremely extensive training and tutorial program. This program introduces you step by step to the intricacies of using the machine.

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First, you are taught how to turn buttons on and off. These buttons are like buttons on the Mac interface, they are basically selectable switches with two states: on and off. On the Write-Top you must tap them with the stylus. Nothing happens when you put the pen down, although the computer registers the stylus position. If you take the stylus up again when it is still over the button, then you are considered to have pressed it. If, however, you slide the stylus away and lift it up, you are not. If you put the stylus down to one side, slide it over the button and lift it off, then it works.

Buttons are used for many of the controls in the programs on Linus. In particular, if you are using the stylus in place of a regular keyboard, buttons are the only way to run ordinary DOS programs. When the Linus is turned on, it checks for an ordinary keyboard. If it finds one, it uses that. Otherwise it loads in a driver for the stylus, loads in a memory-resident keyboard emulator and runs the calibration program. The keyboard emulator, called a soft keyboard, is used when you return from a Linus program to DOS.

At the DOS prompt, if you tap twice, somewhere in the middle of the screen a keyboard appears with each key defined as an individual button. Anything can be typed by tapping the appropriate buttons with the stylus. The Shift, Ctrl and Alt keys all work as they would on an ordinary keyboard except that they are toggles, so it is possible to type combinations requiring more than one key. However, not all the keys are available. In particular, none of the numeric keypad keys are there. There are no Ins or Del keys, no Esc key and no PrtSc key, so you can't reboot from the soft keyboard. The cursor keys are available as directional strokes below the display.

In text display modes, the soft keyboard is the only way to communicate with the computer. All Linus software and associated user interface and handwriting recognition methods use the graphics mode so that a graphic representation of what is written can be displayed.

Once you understand how to work the basic controls, you move onto getting used to writing continuous, flowing movements in an area. This is very similar to using a light-pen with a paint program. When you draw onto the screen, electronic ink appears beneath the stylus. This lets you get a feel for the speed and dynamics of drawing and writing with the Linus stylus.

Learning to write

Writing to be recognised by Linus is done on lined grids. Each line for writing is bounded by solid upper and lower lines and has a dotted line halfway between the two. Small letters should be written under this guide line and capital letters should fill the space between the bounding lines.

There are some basic rules for writing with Linus. The most important is that Linus only recognises disconnected symbols, so joined up (cursive) handwriting is out. You must write each letter separately and complete each letter before starting the next. This means that you can't go back to dot the i's and cross the t's.

The training program also points out the problems the handwriting recognition algorithm has with letters of the same shape. Capital and small letter c's differ only in size and the Write-Top can't tell a small capital from a large ordinary letter c. Other problem letters are j, k, o, t, u, v, w, x, y, and z. In addition, some characters are hard to separate, in particular: o and 0; 2 and z; small q's, g's and y's; and capital C's, small l's, and all forms of opening brackets.

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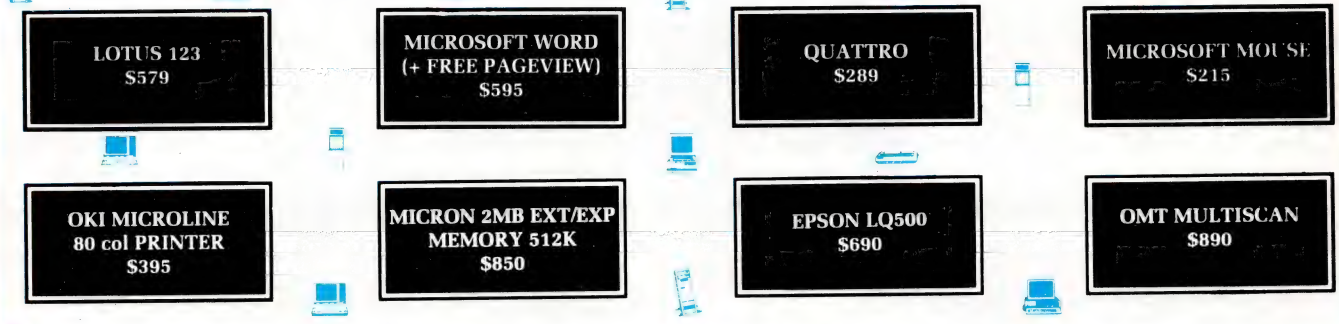
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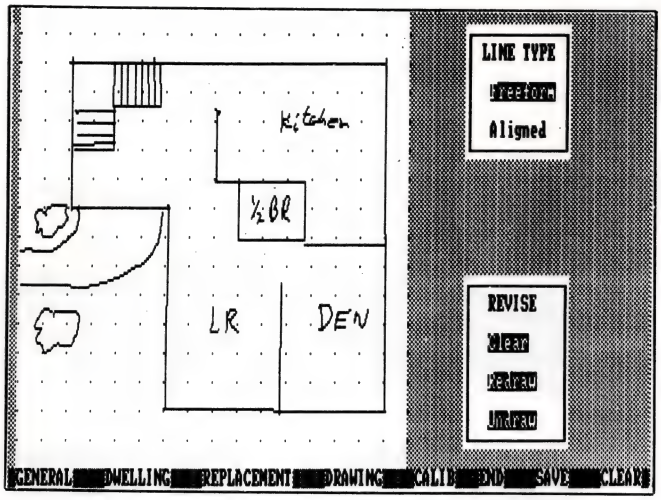
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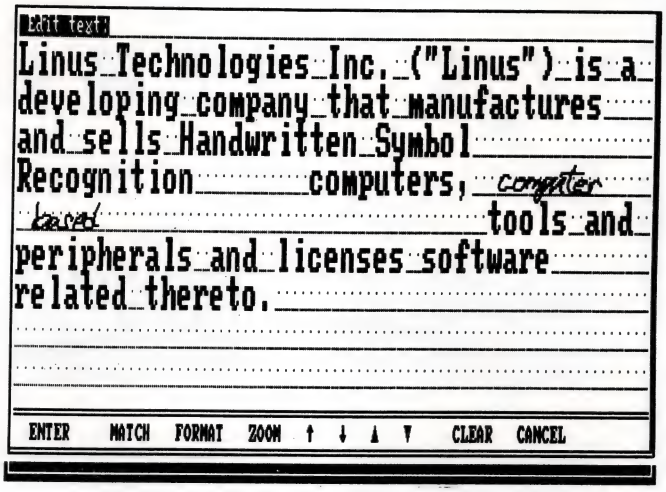
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Text editing is simple: just mark an insertion point and write in the corrections. Characters must be written within the guidelines if they are to be recognised

program warns about is if you write a letter more than one way. Some people give the number 4, or the letter a, two shapes.

It is equally problematical if you pen a character in different ways, but it comes out looking the same. The recognition technology in Linus involves the number of strokes made, their shape, position and size. So for example, a letter c made starting from the top is perceived differently from one starting from the bottom, just as a large stroke in making the capital letter is different from the small stroke in making the small letter. Even the order in which you make strokes is important.

The training program puts you to work creating your own personal handwriting dictionary. You are reminded that for Linus to recognise your writing, you will have to form each letter consistently, make sure that different letters are made in sufficiently different ways, that the stylus is lifted between characters, and that each character is completed before starting the next.

To make the dictionary, you write several different versions of a character and the program selects representative samples. In some cases, if you write a letter very consistently, only one or two samples will be chosen no matter how many you write. In other cases, the program will take six or seven. Editing of written symbols is possible, by clearing the writing window or crossing out one or more symbols. To delete a single letter, you draw a horizontal line through it three times back and forth. To delete a longer line of symbols, you can simply cross them out in one sweep.

Once you have provided samples for letters, you go on to the final stage where dictionaries are updated and revised. Here you can not only enter symbols for the dictionary, but test them with the handwriting recognition algorithm. It is a fantastic sight to write down a phrase or sentence and hit the MATCH button, and see computer versions of the letters replace your handwritten ones. At first these are often incorrect, but as the dictionary is updated, recognition improves.

When you have had enough, you save a dictionary to disk. The dictionaries take up surprisingly little space — typically from 3k to 5k. One of mine takes 4121 bytes, the other more complete one is about as big as a dictionary could get — 11,525 bytes. This is because my handwriting is illegible to everyone except myself and I had to make six or seven versions of practically all the letters. Using the first dictionary in working (not ideal) conditions, about 17 per cent of my letters are recognised wrongly. With the larger dictionary, about 11 per cent are wrong. With practice and refinement it should be possible to get that down to under four per cent. For example, almost all my errors are caused by the capital H and confusion between small n's and small u's.

The subject of errors brings up an important point — correction. A letter can be recognised wrongly, as a different letter, or it can not be recognised at all. In the former case the program puts up the wrong computer letter; in the latter it leaves the unrecognised writing as it was.

To correct something you can simply write over it. When you push the MATCH button, anything new that has been written is recognised afresh and inserted appropriately. You can delete items by crossing them out with three short vertical lines. If you do this between two letters, a single space is inserted. If you do it in a space, a new line is inserted. Similarly, if you delete any space larger than a single space, all but one space is deleted.

When making corrections, recognition generally improves since your attention is drawn to the mistakes you make in writing the offending character. It is very rare to have to try several times to get a character right and, if you have to, it is a sign that your dictionary needs updating.

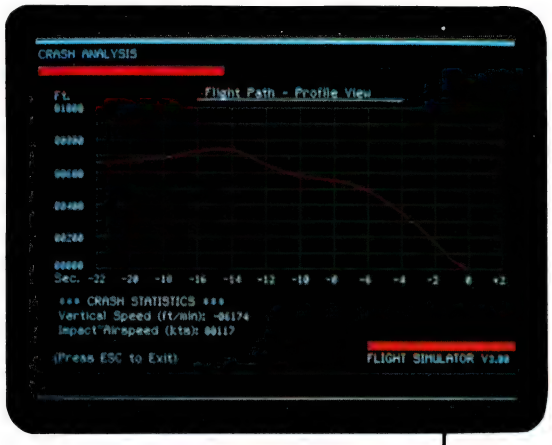
One problem with the Write-Top is speed. It is surprisingly fast at recognising handwriting, but this is still essentially a slow method of data entry. If you try to write more quickly your writing will get sloppier, resulting in a higher error rate, thus using up all the time you saved, and more, in correction.

Software

Apart from the learning program, the Linus Write-Top comes with very little software. You don't even get a full version of DOS, just the Learn program on a bootable disk (DOS 3.3), which also has the DOS Format program so you can create data disks. You also receive the sample applications for patient records and house valuation for insurance.

I also received the editor application, Just-Write II, and some example programs to show how some of the application programs work. The reason so little software is readily available is that the Write-Top is really being aimed at companies who will develop vertical market applications for it and sell the Write-Top and software as a package.

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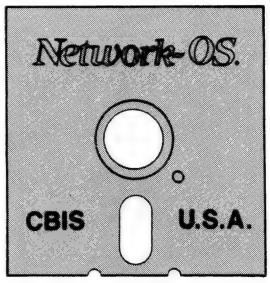
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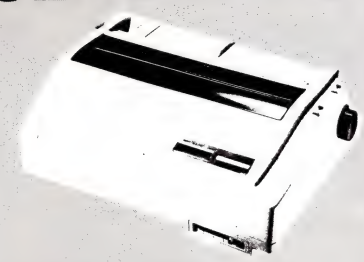
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Several companies are already doing this, with applications for tracking equipment and drug usage in hospitals, or preparing and calculating property appraisals for insurance purposes.

The only software Linus sells are Just-Write II and the Code-Write software development kit. I was unable to try this out, but it is a set of tools for developing Write-Top applications with Microsoft C. Linus is currently working on a version to work with Basic. Code-Write provides the developer with easy access to the user interface with buttons, menus and windows, and more importantly to the handwriting recognition routines. Access is also provided to the stylus detection and display software so that developers can develop drawing and painting-type programs.

The Just-Write II editor is a simple editor that can open any Just-Write or ASCII document. It operates from within a character-based desktop. The desktop has the ability to execute programs and perform file management functions. It is operated by pop-up menus. A menu bar appears at the bottom of the screen when the grey area below the screen is tapped with the stylus. Menus are selected and pop up when an item is touched. To select an item from within a menu, you touch it again. It is an effective and easy-to-use interface.

Properly written applications, like Just-Write II, can split the screen into windows and run copies of the desktop in them. These are controlled by picking up one of their edges and scrolling it. Only tiled windows are allowed, but you can have as many as you want. However, only programs that use the windows (so far only Just-Write II and the desktop) can run within them. Other programs written for the Write-Top can be launched from the desktop, but they take over the whole screen, restoring it when finished. Ordinary DOS programs will not run from the desktop.

To enter text into the editor, you either pick Text Entry from the editor menus or make the editing gesture. Gestures are examples of how the Write-Top can be made to recognise a unique symbol as any kind of command. Since you can only enter text into a text entry box, writing on the document display screen of the editor has no effect, unless one of the letters is one of the gestures.

In this case, if you write a w on the screen, a writing window pops open for you to enter text. You can zoom this to full screen size and scroll it, effectively making the entry as long as you like. However, in practice it makes sense to do about a sentence or so at a time since it takes the computer a while to recognise a lot of symbols at once. If you are sure what you write is good enough, you can hit Enter straight away rather than MATCH. If the computer can match all the symbols you write, the information is entered straight away. If it can't, it beeps and displays what it would have shown if you had pressed MATCH.



Linus sees vertical markets such as hospitals and engineering as obvious environments for the Write-Top

The editor is fairly basic. You can mark blocks, cut and paste (even between windows), save files and print them out to any ordinary text printer. Various formatting options affect line spacing and things like flush left and right. And there are search and replace options, and some system options, which are also available from the desktop.

If you turn the computer off, it will return when re-activated to precisely where it was, unless it was at the DOS prompt in which case it reboots. The tiny recessed button is used to perform a hard reset if this should be necessary.

The demonstration programs I saw involved filling in electronic forms by pressing buttons to select options and by filling in pop-up text boxes where necessary. One let the user save a freehand drawing record for any other information like signatures or diagrams. I also saw a very preliminary CAD package which had ellipse and line drawing and snap-to-grids. All of these were fully controlled using only the stylus and were very easy to use.

Performance

Using the Write-Top with various pieces of ordinary DOS software was very frustrating. Everything worked perfectly except when Ins, Del or Esc were required. But, entering keystrokes by typing them on the soft keyboard was irritating.

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Write-Top has two serial ports (one for the internal modem) and a parallel port, and that it was operated by an NEC V20. It indicated that the Write-Top was 165 per cent the speed of the original PC. Norton's SI gave a figure of 5.1. I also ran the *APC* benchmarks, the results of which suggest that the Write-Top is pretty nippy.

I was able to run Procomm to test the modem and also LapLink to test transfer via the serial port. Everything worked fine except for some general awkwardness and not being able to press Esc. One interesting result was from a program that maps memory to show what memory-resident programs there are and how much space they use. It showed a resident program called TSRSPACE occupying 32k and the soft keyboard occupying a cool 88k. The game Digger ran fine but refused to recognise the soft keyboard, probably because it uses its own keyboard routines.

All in all, the Write-Top is fairly compatible, but if you really want to run DOS programs on it, you will need a separate keyboard.

Practical use

There is only really one major area left to consider — what use is the Write-Top? When you sit down and start using it, and when you have overcome the phases of initial scepticism, mounting excitement, delirium and creeping boredom, you realise that the practical uses of the Write-Top are limited.

Data entry using handwriting is just too slow compared with the keyboard. Linus realised this long ago and that is why the company doesn't make a big fuss about the computer and why it stresses vertical market applications.

At the moment, Linus is only interested in selling to companies with applications where keyboard entry really is impractical. This is why the company went to so much trouble to make the computer easy to access when being carried and why the Note Pad has been designed to be light and simple to use.

Linus foresees applications for onsite computing in places like operating theatres — for tracking equipment and drug use both for accounting and for patient health; in construction industries for site planning; for insurance appraisal on the site of the property or item being insured; for surveyors recording information during a survey; for accountants making direct changes to spreadsheets while meeting with clients so that they can be advised of budgeting amounts immediately; and so on.

Prices

Linus Technologies has not yet appointed an Australian distributor — though it is looking for one. In the meantime, interested parties will have to purchase the Write-Top directly from the US. The machine is surprisingly inexpensive given the amount of proprietary technology inside it. A minimal configuration without a modem costs $US2795, while one with a modem costs $US3100. The Just-Write II editor costs $US299 and the application developer kit Code-Write, which includes source code and examples, costs $US5000.

The future

It is the future of Linus that is most interesting. The chairman of Linus and inventor of the Write-Top, Dr Ralph Sklarew, forecasts that shortly after 1989 the company will have models capable of recognising freeform symbols. This will mean that complex symbols and perhaps even cursive handwriting could be recognised.

In addition, he anticipates that the whole computer will be less than 2.5cm thick and will be available in sizes varying from memo pad to full desktop or even drawing board size. The technology to make it that thin is already here. A complete PC motherboard can be made only 5cm by 10cm in size and about 0.84cm thick. If battery-backed credit card memory is used, then the hefty base unit won't be needed. I leave the possibilities to your imagination.

Conclusion

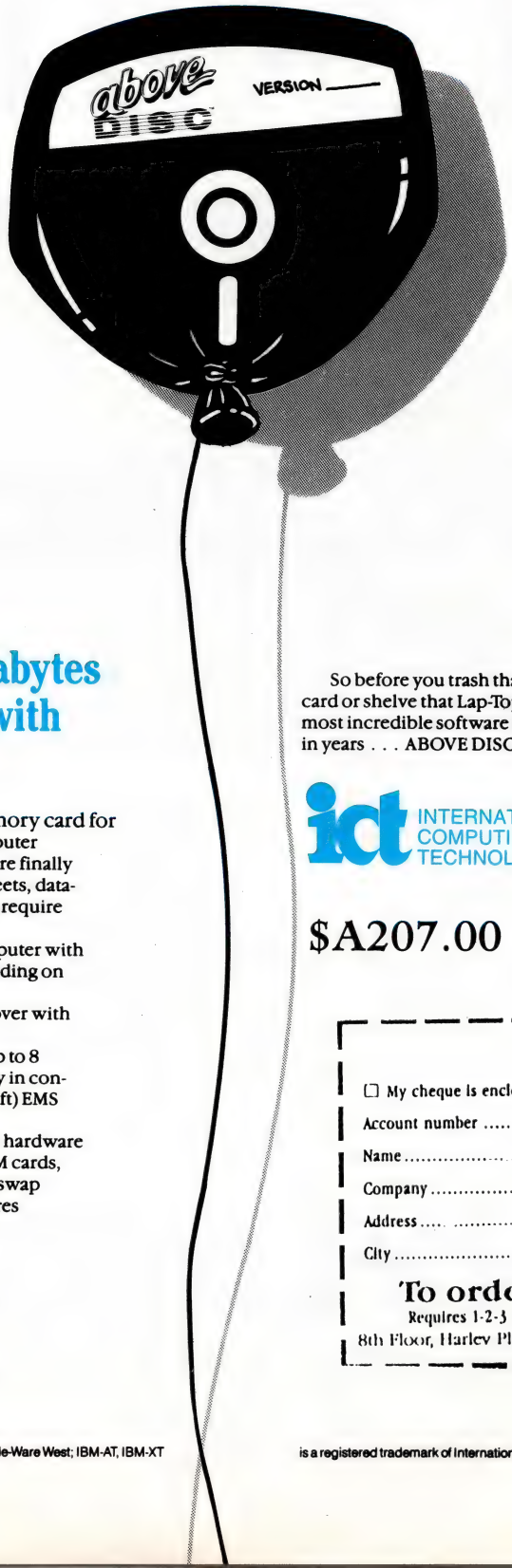
The Linus Write-Top is a useful working computer, fun to play with for the average user and potentially very useful in some niche markets. The stylus and display technology work perfectly and the handwriting recognition is fairly good — certainly good enough to use and easily good enough to confound sceptics. It's certainly a good idea.

However, in its present form the Write-Top is only useful where the keyboard cannot go. Once it can recognise more complex symbols and can separate multiple symbols joined together, it is certain to become a method of input at least as standard as the keyboard. Handwriting technology instantly quadruples the number of people who will have access to personal computers. Write on, Linus!

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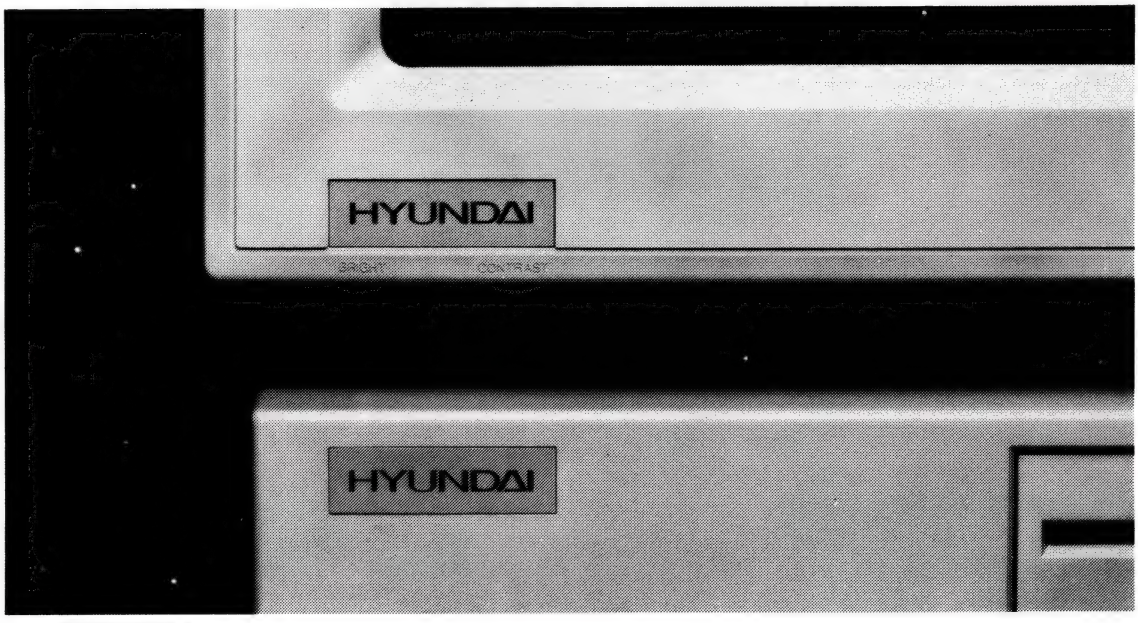
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DP



Text retrieval with ISYS

Phil Cohen looks as ISYS — a text retrieval software package for personal disk searching and database retrieval — and comes out with good vibes.

I suspect that I'm a fairly tough reviewer: I usually find something nasty to say about almost every product I review. I've been reviewing computer hardware and software for 10 years and for more than a dozen publications, and I don't think I've ever given a product 10 out of 10. Glasgow (my home town) is known as a difficult place for a comedy theatre company to play in, probably for much the same reasons. At least one major computer manufacturer has specifically asked the publisher of this magazine not to give their machines to me for review (I'm glad to report that the publisher did anyway).

The reason I'm giving my credentials is that there is a link between the company that launched ISYS — Odyssey Development — and *APC*. The software was written by Ian Davies, who frequently writes for *APC*. There is no link between myself and the publisher (I'm freelance) and no link between Odyssey and *APC*. Having got that off my chest, let's get on with the review.

ISYS is a text retrieval system: it allows you to search a large number of files for occurrences of particular words. There are two areas in which a text retrieval system is useful: for finding things on a badly-organised personal hard disk, and for large database retrieval.

First, let's talk about what the insides of most people's hard disks look like . . .

Now, I must admit to being pretty well organised (at least when it comes to file names!). I have a directory called \WORK, which has one subdirectory for each job I'm working on. The data files all go into particular job subdirectories, and the software goes into a totally different directory called \SW. That way, I can back up only data files, by backing up all of the subdirectories under \WORK.

'A text retrieval system will let a badly-organised user find any document on their hard disk just by asking what word or phrase it might contain.'

I name my files the same way in the \WORK subdirectories — reviews are all called REV.TXT, proposals are all called PROP.TXT, and so on. So when I want to find something, I generally know where to look.

However, that's not how most people work.

Most people, when installing a package like WordStar, put it into a directory called \WS. Then all of the text files they create also go into \WS, along with their software. They name their files LETTER.JOE and LETTER.ALF, so that they get the same backup file name for both of them. Sometimes they number them instead: LET1, LET2.2, and so on. After only a few months it is absolutely impossible for them to find a given letter, memo or proposal.

A text retrieval system will let a badly-organised user find any document on their hard disk just by asking for what word or phrase it might contain. For example, you can tell the system that you are looking for a letter containing the word 'Fred'. It will immediately produce a list of possible letters, and let you look at each one to find out if it is the one you are looking for.

It will even let you restrict your search to letters that contain 'Fred' and 'Jones' in the same paragraph. Or to letters that contain 'Fred' but not 'Smith', and so on.

The other area in which text retrieval is useful is in the searching of large databases. Let's say you have the complete text of every report ever produced by your company, sitting on a huge 120Mbyte file server. One day you want to find every reference in those reports to wide-area networks. You call up your text retrieval system and tell it to look for any document that contains 'wide area network' or 'WAN'.

Now, there is text retrieval software around for both of these applications — personal disk searching and database retrieval. But none of the packages I've seen are very good.

For example, the large database searching software is usually pretty clunky. It

forces users to learn special keywords (like '.and.' or '||') and generally acts like it was written by mainframe programmers — which it was.

The personal disk searchers are much friendlier, but they run out of steam on big systems, and many of them won't even look at a LAN.

Enter ISYS

ISYS was developed wholly in Australia, and is definitely in the PC software mould. It has as good a user interface as I've seen on any PC package: and I've seen a few. It also has plenty of grunt. ISYS will handle up to 65,000 files, each of which can be up to 65,000 paragraphs long. It will typically find the reference you're looking for in a second or so, even on very large databases.

ISYS works by building an index to a subset of your files — you tell it what files you want indexed, and what word processor you've used to create them. For example, you can tell it to index all .TXT files in the \WORK directory and treat them as WordStar files, plus any files in the \SW directory that are not .COM or .EXE files and treat them as flat ASCII.

The index will take up around 30 per cent of the space your files (only your text files, remember) already take up. Building the index is something you can have the machine do as you leave the office each day: it takes about a minute per 15k of altered text file, though it only needs to look at the files that have changed since the last index update (it knows which ones have changed without you telling it).

Of course, if you're working with a large database on a LAN, you will schedule the update to happen in the middle of the night, when no-one is using the file server. ISYS is designed to be able to operate in a LAN environment: it will work with most of the commercially-available LANs.

Using ISYS is a breeze. In fact, it's so easy to use that Odyssey has taken the unusual step of using the software to sell itself. The company will be distributing 35,000 copies of ISYS (modified, of course, so that they will work only with small numbers of files) free throughout Australia by inserting the disks into magazines. People receiving the disks will be able to order ISYS by phone.

Although the disks will each have an abridged manual included, it's unlikely that anyone will bother to read them before they install the package. Even so, I don't think many people will have problems with it.

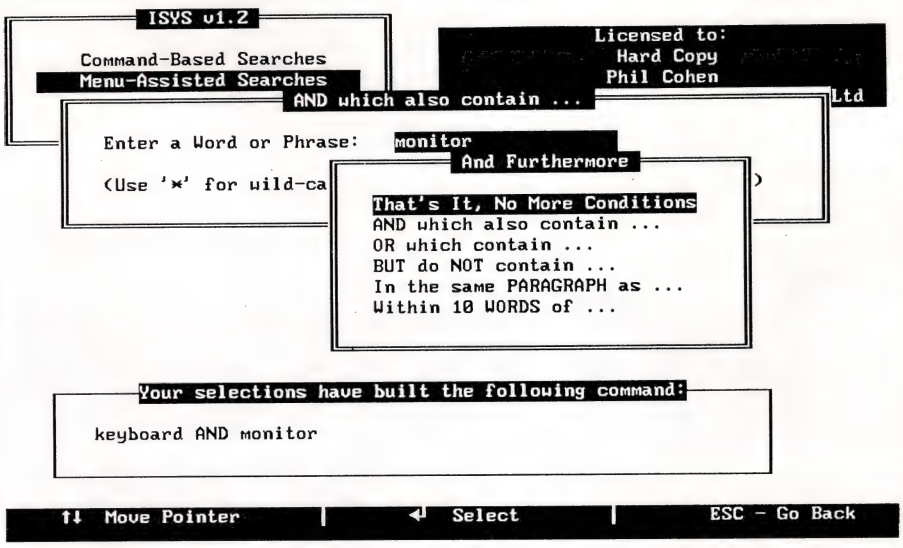


Fig 1 The options for menu assisted searches

Installation

Installation is very straightforward, and there is no copy protection. The installation process includes asking you which word processors you use (ISYS presently supports MultiMate, WordStar, WordPerfect, Professional Write, Word, DCA (IBM's text format), and flat ASCII) and which file names you use for them.

To build an index for your files, you simply type IDB CREATE and then IDB UPDATE. Typing IDB UPDATE later brings your index up to date.

'ISYS is designed to be able to operate in a LAN environment: it will work with most of the commercially-available LANs.'

Having created an index, you can find text at any time by typing IQ and following the instructions. ISYS lets you form queries in two ways: by typing a single command line with keywords, or by working with a menu.

ISYS keywords are generally just words like 'and' and 'or', but you might find it easier to use the menu for the first few times (see Fig 1).

'AND' means that both of the words must be in the file; 'OR' means look for all files that contain one or the other word; 'NOT' means exclude files that contain this word; '//' means the words must be in the same paragraph; '/10/' means that they must be 10 or less words apart.

You can also add a wildcard to the end of a keyword: 'actua*' will find 'actual', 'actually' and 'actuarial'. And you can combine your search criteria with brackets, in a true boolean equation.

Having accepted your query, ISYS will find the files that match it. Then it will present you with a list of possible files (see Fig 2), and also tell you how many times the word(s) you requested appear in each file.

By moving the highlight bar to the file name you want to look at and pressing the Enter key, you can bring up the text of each file, at the position of the first instance of the word(s) you are looking for (Fig 3). It's as simple as that.

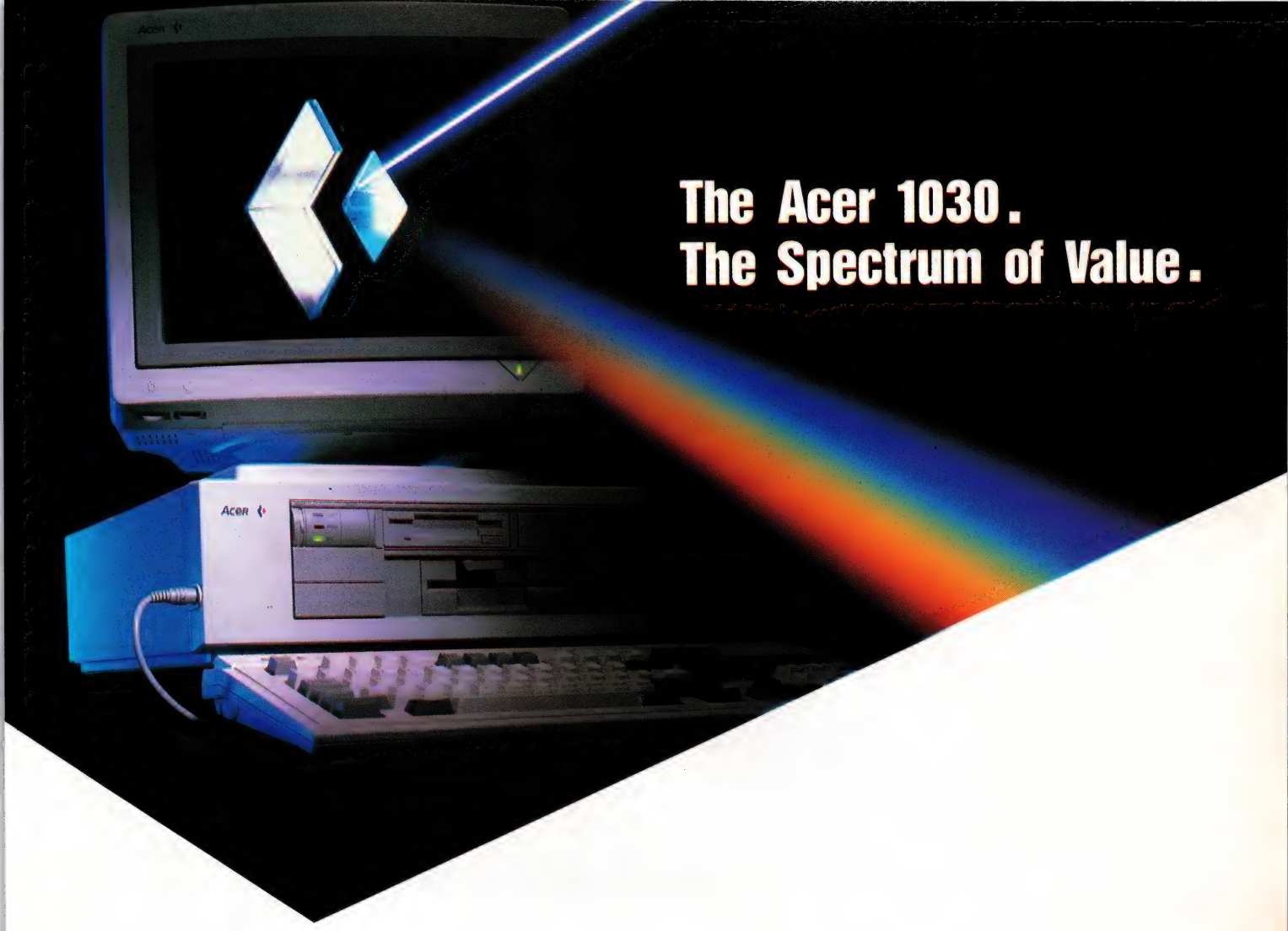
ISYS will automatically translate the format of the word processor file it found the words in, so that you can scan back and forth in the file to look at the rest of it.

Features

Now all this is pretty impressive, but the best is yet to come. By typing IQ LOAD from DOS you can make ISYS memory-resident. That means that whenever you type Alt-I from within any application (WordStar, dBASE, or whatever), ISYS will pop up.

Then you can execute a search to find the particular file or part of a file you want, and finally copy some of that file into the application you were working on when you called ISYS.

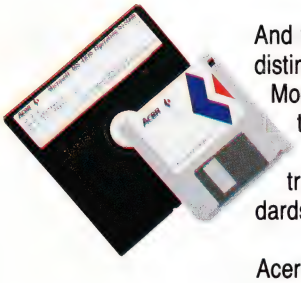
Another way to use ISYS is to add your query to the DOS command that calls it up; for example: IQ CONTEXT = KEYBOARD AND MONITOR will find all



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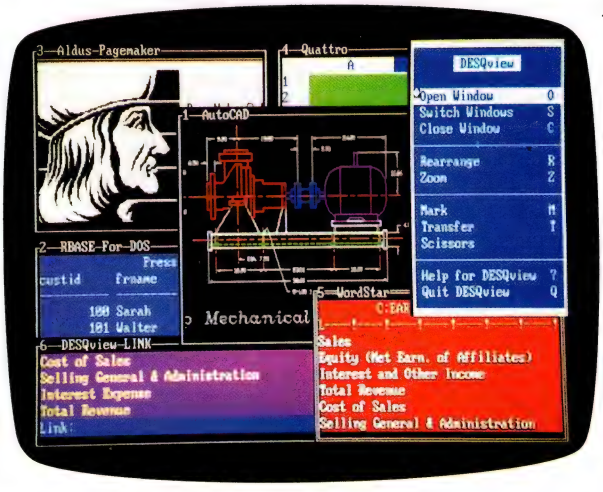
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of the files that contain both 'keyboard' and 'monitor', look at all of the 'contexts' (ie the lines immediately preceding and following those words), and print them to the screen.

This way, you can use ISYS to run frequently-needed queries by putting the whole command into a batch file, or you can interface ISYS to other applications (including, for example, dBASE).

What surprised me most about ISYS was the depth of thought that had gone into the design. For example, after playing with the package for a while, I thought I'd try out some of the statistical reports it generated. I asked it to produce a list of all of the words it had indexed on my machine, with the frequency of occurrence of each word.

That worked fine, but there were a lot of words — I wanted to know which ones I'd used most frequently. A quick look in the manual showed me how to restrict the list to words over a certain frequency: just what I wanted.

Normally, when a package is first released, there are many things missing from it: limiting the frequency of occurrence report to just some words is the type of thing that gets left out. Not so with ISYS.

Another gem: when you are using ISYS in its memory-resident mode, you can call up the last few queries you gave it just by pressing the up-arrow key. They're all still there — just the sort of little detail that gets missed in the first general release of a package.

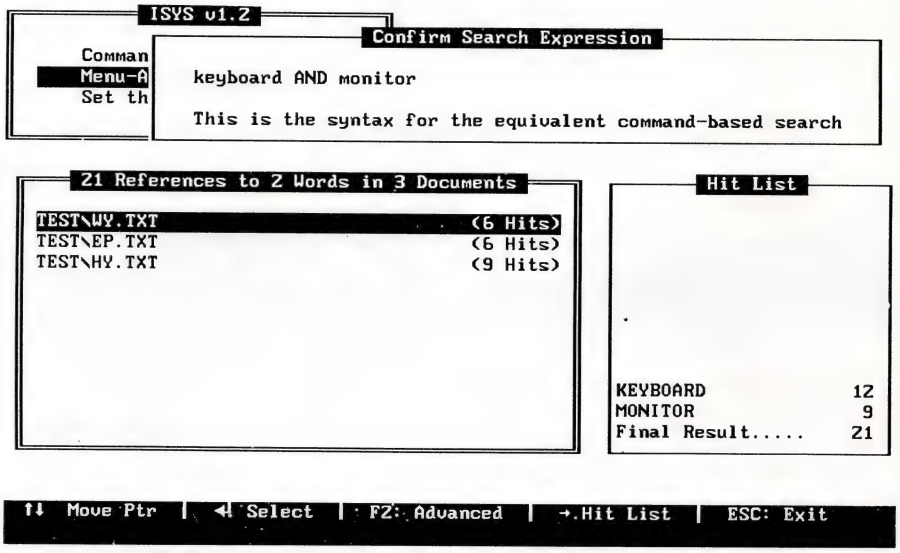


Fig 2 ISYS presents you with a list of possible files and tells you how many times the word(s) you requested appear in each file

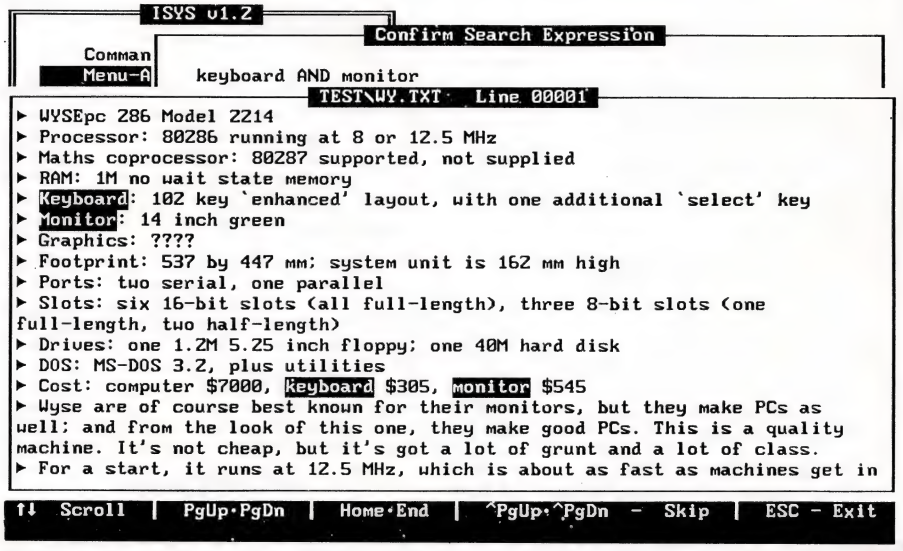


Fig 3 By moving the highlight bar to the file name you want and pressing Enter, you can bring up the text of each file

Documentation

The documentation for ISYS is excellent. As I write this, the manual hasn't been printed; I was given a laser-printed draft (looks like Ventura). But it's 200-odd pages long, has a quick-start section up the front, a proper index that works, a wealth of technical background, and generally looks like a very professional piece of documentation. And that's from someone who is in the business of writing manuals!

It's about time that people realised that you can't release software these days without decent documentation. From my experience, the more expensive the product, the worse the documentation. A $99 PC pop-up utility will always have a bound manual with a colour cover, well written and well presented. A $99,000 mainframe package will have photocopies of the overhead transparencies used in the training course. Ah well.

Talking of pricing, ISYS is not particularly cheap for a single-user application. The one-off price is $486 including tax. But when you look at site licences it gets cheaper, with the cost per user dropping to around $250 for a 10-user system. That makes it a moderately-priced PC package, and a very cheap multi-user package.

Conclusion

ISYS won't be short of applications; there must be quite a lot of text sitting around on PCs these days. Most large organisations are looking at LAN/file server systems for word processing, electronic mail and general office text handling, and ISYS is ideally suited to that sort of environment. As for personal use, a friend of mine has been running a newsletter for a number of years, and would very much like to be able to search the accumulated text for references.

ISYS is a quality product. It has been very well designed and is more than powerful enough to replace the clunky mini and mainframe text retrieval applications that have been knocking around for the past few years. And it was developed entirely in Australia.

END

Phil Cohen is a director of Hard Copy, a Sydney technical writing company.

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Borland beefs up its languages

Turbo C and Turbo Pascal get upgrades, but as Rick Grehan and Tom Thompson find, the big news is an assembler and a debugger.

Borland International is well known for its low-cost line of development languages: Pascal, Basic, Prolog and C. But up to now, if you really needed to get down close to the silicon by using assembly language or debugging your wayward masterpiece of code when it sporadically crashed, you had to look elsewhere. No longer: Borland has closed this breach by introducing a high-speed assembler and a powerful standalone debugger. If that isn't enough, the company has upgraded its premier development languages — Turbo Pascal and Turbo C — with built-in source-level debuggers.

The Turbo Assembler and Turbo Debugger are entirely new. Being a lowly assembler, TASM operates more or less in a line-oriented environment; happily, it operates noticeably faster than other assemblers. The Turbo Debugger is possibly Borland's best release of this group. Like TASM, the debugger boasts support for the complete line of 80x86 processors and 80x87 coprocessors.

Turbo C 2.0 and Turbo Pascal 5.0 feature their usual integrated development environment, which consists of the compiler itself, a WordStar-style program editor, and source code debugging capabilities. Both compilers make use of expanded memory, provide faster floating-point emulation, have in-line assembly language support, and support the new standalone debugger. If you shun this integrated environment in favour of a program editor that you're comfortable with, each Turbo language also provides a command-line-interface version.

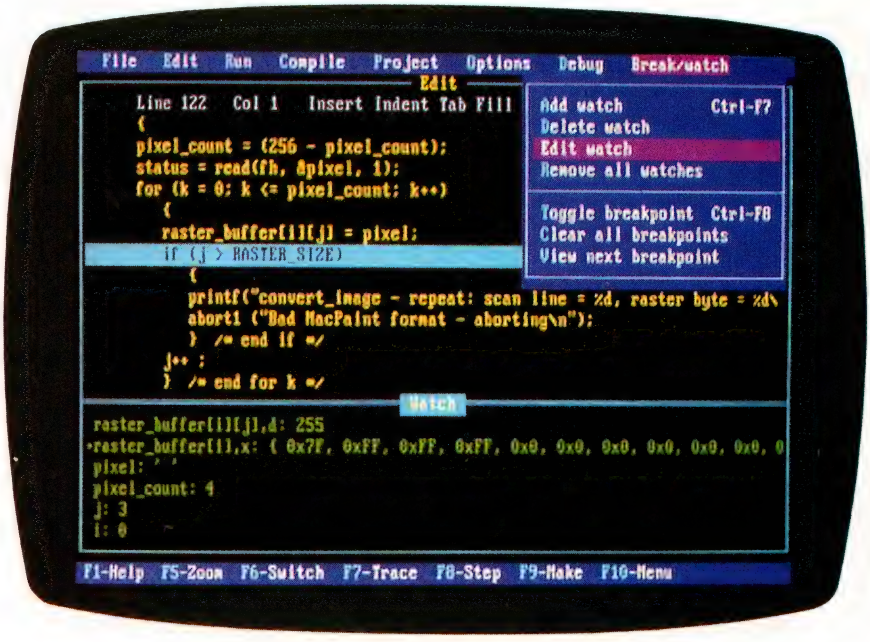


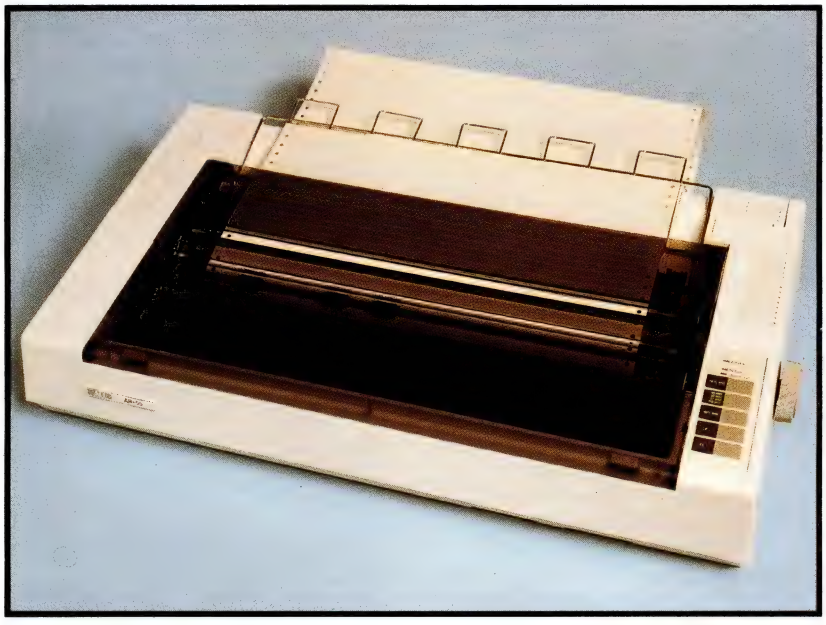
Fig 1 Turbo C's built-in debugging facilities highlight the statement being executed. At the bottom, you can see variables that are being 'watched' and their contents. You can examine the contents of an array row, or an individual cell in the array. Also note that you can specify the output format of the displayed data

Sound familiar? Yes, Microsoft's Quick languages give you the same option.

Turbo C 2.0

Turbo C 2.0, like its predecessor, supports every conceivable memory model: tiny, small, medium, compact, large and huge. It now supports the 'long double data' type and adds new 'raise' and 'signal' functions. The 'raise' function signals a hardware exception, and the 'signal' function lets you respond to the exception, either by two predefined handlers or by your own handler. The edit buffer makes use of the Expanded Memory Specification (EMS), freeing an additional 64k of RAM to compile and

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debug a program. An 'asm' keyword lets you add assembly language statements directly into your C code. To use this feature, though, you'll need TASM, since Turbo C generates an assembly language file rather than a linkable object code file when you use this option.

Turbo C 2.0 comes on six 360k 5.25in floppy disks and requires 448k of RAM and MS-DOS 2.0 or higher. It sells for $197. We installed a beta version of the 2.0 compiler on an Epson PC with a 10MHz 80286 processor, 640k of RAM and a 30Mbyte hard-disk drive. Turbo C has no installation program: you copy the contents of the floppies to your hard disk, or just the libraries you need. Turbo C Professional, a $378 package with Turbo C 2.0 and new assembler and debugger, will be available in Australia mid-October.

When you start Turbo C, it looks a lot like Microsoft's QuickC: it has a menu bar and you can access the menus and menu items with one or two keystrokes. The most immediate difference between version 2.0 and version 1.0 is the new Break/Watch menu, which is quite similar to QuickC's Debug menu. It lets you set and clear breakpoints as well as set 'watches'. A watch is a display of a variable's contents, and the display is dynamically updated as the program runs.

The built-in debugging facilities, which operate identically for both Turbo C and Turbo Pascal, are easy to use and powerful (see Fig 1). Pressing F7 single-steps you through the program source code, line by line. On a colour monitor, a bright bar of colour highlights the statement being executed. You can set a breakpoint by stepping the program to the statement of interest and selecting Toggle Breakpoint from the Break/Watch menu. The source code statement thus selected is highlighted in a colour different from that of the other statements — a nice touch if you're plodding through a lengthy trace. Or, you can move the editor cursor to the target statement and select Go to Cursor from the Run menu.

With the Break/Watch menu, you can also examine the contents of arrays and structures by means of a watch. The contents of the target variable are displayed and are updated as their contents change. You can have the watch variables displayed in a particular format, such as hexadecimal, decimal integer, real, character, Boolean and pointer.

We used a C compiler benchmark to compare the performances of Turbo C 1.0 and 2.0. This benchmark is the source code to XLisp and consists of 24 files. It's compiled with the large model option. Turbo C lets you define and build 'projects' that reference multiple source code files, so we set up an 'XLISP.PRJ' file. Turbo C 2.0 compiled the project in two minutes, five seconds, versus the two minutes, 40 seconds required by Turbo C 1.0. The preliminary documents for version 2.0 claim that it's about 10 per cent to 30 per cent faster than its predecessor. The benchmark pegs it at 21 per cent. We also compiled the source code for the Sieve, Sort and Fibonacci benchmarks. The version 2.0 benchmarks ran as fast as those for 1.0, except for the Fibonacci, which ran two seconds slower.

Turbo Pascal 5.0

Like Turbo C 2.0, the Turbo Pascal 5.0 editor can make use of EMS memory. It features the ability to generate programs larger than 64k; has new built-in procedures such as 'Inc()' and 'Dec'; and supports several new data types, including 'longint', 'shortint', 'word', and the IEEE floating-point formats. It also offers compatibility with Turbo Pascal 3.0 and 4.0. An 'inline' statement has been expanded: formerly you could insert inline assembly language statements within Pascal source code using this keyword, but now you can declare entire procedures or functions to be of type 'inline'. These functions then act like macro expansions: every time the procedure/function name is encountered, all the assembly code within it will be directly inserted into the Pascal program.

Priced at $228, Turbo Pascal 5.0 comes on either three 360k 5.25in disks or two 720k 3.5in disks. The package requires MS-DOS 2.0 or higher, one floppy-disk drive and 448k of RAM for the integrated environment or 256k for the command-line interface. We installed a beta version of Turbo Pascal 5.0 on the same Epson PC that we used to test Turbo C. Turbo Pascal does come with an installation program that asks you several questions and then prompts you for the disks. The compiler's source-level debugger is the same as Turbo C's. The $378 Turbo Pascal Professional version, with the assembler and debugger, is also available.

For performance measurements, we compiled the source code for the Pascal/S compiler. For comparison, we did the same using Turbo Pascal 4.0 This also tested the claimed compatibility with older versions of Turbo Pascal, since the MS-DOS implementation of Pascal/S includes a 'Turbo3' unit. Both 5.0 and 4.0 compiled the 2074 line program without errors in about the same time — 4.8 seconds. Next we compiled the p-code interpreter for the Pascal/S program and used the newly-created Pascal/S compiler to compile two example programs. We then ran the resulting p-code with the interpreter program. Both the interpreter and the programs ran without problems.

TASM 1.0

One of TASM's high points is support for the 80x86 processor family, namely the 8088/8086, 80186, 80286 and 80386. (For the 80386, though, it has no protected-mode environment similar to the one that's provided by Phar Lap's RUN386.) TASM also recognises coprocessor op codes for the 8087, 80287 and 80387. TASM runs on IBM PC compatibles with MS-DOS 2.0 or higher and 256k or RAM. The assembler is sold in a single package with the new debugger for $228.

If you activate the '/JJUMPS' command-line option (or use the 'JUMPS' directive), TASM performs automatic jump sizing. This means that when the assembler encounters a conditional jump whose target is out of range, the assembler will recode the jump as a conditional branch around a nonconditional full-segment jump. So, if you have automatic jump sizing activated and TASM encounters 'JNZ TARG' and determines that 'TARG' is out of the jump range, it will emit

```
JZ $+5
JMP TARG
```

since the destination of an unconditional 'JMP' instruction can be anywhere within a 64k segment.

TASM is equipped with the 'STRUCT' and 'RECORD' directives, mechanisms for defining complex data structures. These directives are available in the Microsoft Macro Assembler (MASM) as well, but TASM adds the 'UNION' directive for defining a single location as having multityped access (this is similar to C's 'union'). For example, the definition

```
WORDORBYTE UNION
BYBYTE     DB          ?
BYWORD     DW          ?
WORDORBYTE ENDS

LOCATION   WORDORBYTE  <?,?>
```

lets you reference 'LOCATION' as either a word or a byte. So, you could use 'MOV [LOCATION.BYBYTE], 255' as well as 'MOV [LOCATION.BYWORD], 30000' to store a value into 'LOCATION'.

Perhaps TASM's biggest feature is the information contained in its 580 page

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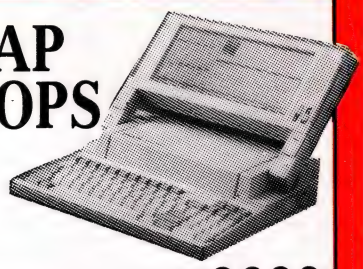
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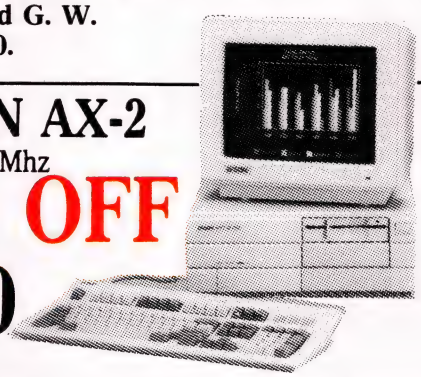
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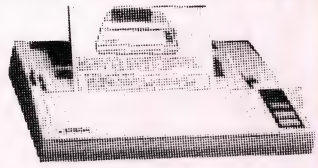
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user's manual. In these pages you'll find — among other things — a helpful tutorial on the pitfalls of programming in assembly language. The tips range from the absurdly simple (eg, forgetting to return to DOS), to the mistakes we all make when we've worked late into the night (eg, reversing operands, such as entering 'MOV DX,AX' when you *really* meant 'MOV AX,DX') and on up to the fiendishly subtle (eg, forgetting that, after a string-manipulation instruction using a 'REP' prefix, the SI and DI registers are left pointing one element away from the last address processed).

We were also impressed by the chapters on interfacing assembly language to Borland's Turbo C, Turbo Pascal, Turbo Basic and Turbo Prolog. Each section covers parameter-passing conventions, register-passing conventions and coping with processor segmentation. We tested a beta version of TASM using the source code for the 8088 version of Small-C, which consists of four files ranging in size from 28k to 65k bytes. Table 1 shows how TASM fared against MASM 5.0. As you can see, TASM is an average of 2.5 times faster than MASM.

We also used the Turbo Linker, TLINK, to create the executable code for the Small-C compiler. This required that we link the TASM-generated object files together with the run-time library file, which we had created some time ago with Microsoft's library manager. TLINK readily accepted the run-time file, and we had a running version of Small-C in much less time than it had taken before.

Turbo Debugger

Now that you have all these languages so you can grind out code to your heart's content, the next requirement is obvious: a debugger to fix all the mistakes you're sure you won't make.

The Turbo Debugger proudly continues the tradition of Borland's windows that we've seen in the company's other language products. The debugger defines two kinds of menus: pull-down menus for activating major functions whose contents are typically static, and pop-up menus for entering information. (Macintosh programmers will see the similarity with the Mac's pull-down menus and dialogue boxes.) Although the Turbo Debugger does not have a built-in editor, you can configure it to fire up your favourite editor from a pop-up menu when you're in the midst of a debugging frenzy.

Another powerful feature of the debugger is that it's polyglot; it lets you perform source-level debugging on Turbo C, Turbo Pascal and TASM programs. Turbo Basic will be added in a future release. The capabilities of the debugger in source mode are quite extensive, particularly in that you can perform expression evaluation operations in the high-level languages from within the debugger. If you're working on a Turbo C program, you can enter complete C expressions (including functions), even while debugging within an assembly language routine that your C program has called. This is powerful stuff, since you can view the contents of a memory location cast as you might use it in a C expression. For example, '(long far *) 0x4000: :14' lets you view the contents of memory location 14 in segment 4000 hexadecimal as though it were a far pointer.

For Turbo Pascal, the debugger can evaluate the language's full syntax with the exception of string concatenation and set operators. Finally, Turbo Debugger can evaluate the complete assembler syntax when you're debugging TASM programs. You can even modify executables created by Microsoft 'LINK' to work with Turbo Debugger.

To run Turbo Debugger, you need DOS 2.0 or higher, 384k of RAM, and an 80 character screen. Borland recommends that you have a hard-disk drive, though the company says that a dual-floppy system works fine. If you want to use Turbo Debugger on one of Borland's other language products, you'll need the following versions: Turbo Pascal 5.0, Turbo C 2.0 or TASM 1.0.

When you activate Turbo Debugger, it loads the program to be debugged, opens the module window, and positions a pointer to the start of the file. From here you can move around in the source

Filename	TASM 1.0	Microsoft MASM 5.0	Source file (bytes)
CC1.ASM	7.24	18.53	65,128
CC2.ASM	5.34	13.17	44,318
CC3.ASM	7.03	18.93	65,323
CC4.ASM	4.33	9.42	28,043

Table 1 Test results show that TASM easily outperforms Microsoft's MASM on the benchmarks. All times are in seconds

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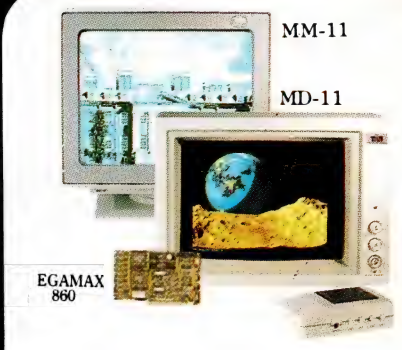
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code, set breakpoints and watch points, and do much of what you can in the integrated source-level debuggers described already. What's new is that you can open Turbo Debugger's CPU window and step down a level into the real insides of the system.

The CPU window is made up of five components, called 'panes'. The code pane shows assembly language instructions intermixed with their generating high-level expressions (if you're debugging the output of a high-level language). Inside the stack pane you can see the contents of the word at the current stack pointer as well as one word above and below.

The data pane displays a hexadecimal dump of a selected region of memory. Typically, you use the data pane to watch blocks of memory in your data segment for activity, but you can set this pane to view anywhere in system memory. You can also alter the data pane's display format to be hexadecimal bytes, hexadecimal words, long hexadecimal integers (the 'C long' data type and the Pascal 'longint' type), eight byte decimal integers (the Pascal 'comp' type), short floating-point numbers (scientific notation), six byte real numbers, eight byte 'double' numbers, or 10 byte extended floating-point numbers.

The registers pane provides a continuously updated display of the CPU registers, while the flags pane shows the state of each of the CPU's flags. And yes, if you select either the registers or flags pane, you can muck around with the processor's internals all you want.

Each pane has its own pop-up local menu. For example, in the code pane's local menu, you can select the 'FOLLOW' command to see where a jump instruction will go if the jump is taken. You might also be debugging inside a subroutine and want to know what function called that subroutine; use the 'CALLER' command.

If you've got a numeric coprocessor installed in your system, Turbo Debugger will sense its presence and let you activate a numeric coprocessor window (see Fig 2). This window is similar to the CPU window in that it lets you probe the internals of the floating-point unit; you can examine and interactively modify the floating-point registers as well as the coprocessor's status and control flags. This feature is unique among debuggers.

For anyone with an 80386 system with at least 700k of extended memory, Turbo Debugger can operate in 'virtual debugging mode'. In this arrangement, the debugger loads itself into extended memory and operates your program from protected mode — which means

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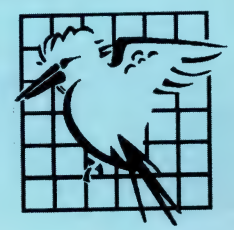
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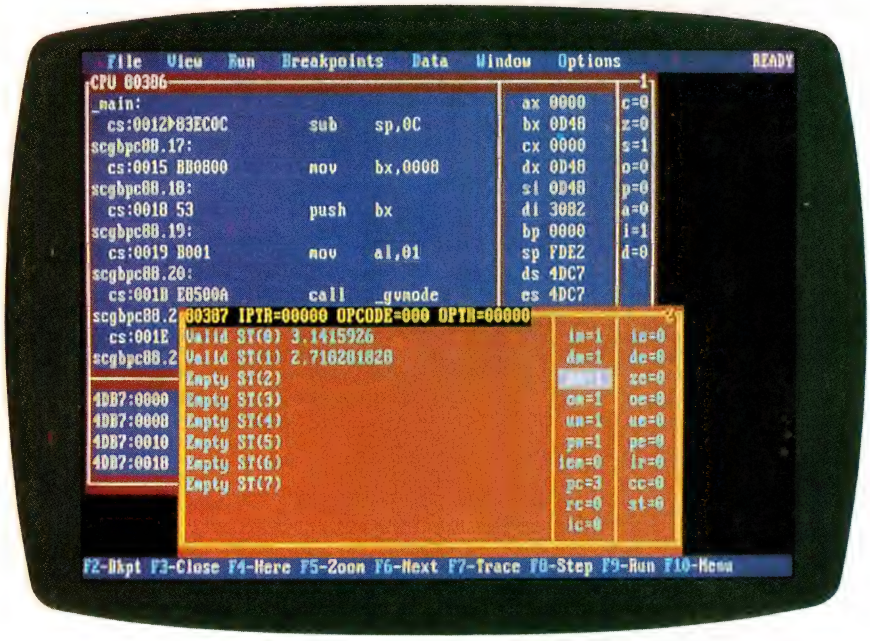


Fig 2 Turbo Debugger's numeric coprocessor window lets you dive into your system's floating-point unit (in this case, an 80387). Notice that you can enter numbers directly into the coprocessor's registers



Fig 3 Remote debugging with Turbo Debugger. The machine on the left is executing the low-level graphics benchmark program, controlled via a serial connection with the machine on the right running the debugger

that whatever you're debugging has free run of the lower 640k. It also means that you can't run a virtual debugging session with software that uses the 80386's virtual or protected modes (such as DESQview, Windows/386 and Compaq's EMS simulator).

The Turbo Debugger's main attraction is its remote debugging (see Fig 3). Anyone who has used CodeView to debug a graphics program and gone dazzle-happy while it flipped the screen from mode to mode will appreciate remote debugging. Simply put, you hook two machines together via serial ports. One is the debugging station, from which you execute Turbo Debugger as you normally would. The other is the remote target, on which the program under question executes, shepherded by a small program (about 20k long) named 'TDREMOTE' that communicates with the debugging station. In this way, the program's keyboard input and display output take place on the target, circumventing the annoying interleave of debugger I/O with the debuggee I/O. This is also handy if you're developing a software monster that's too big to crowd into memory with Turbo Debugger running standalone.

The remote link can operate at three data transfer rates: 9600bps (bits per second), 40,000bps, and 115,000bps. With a beta version of the debugger, we ran a quick remote session between a 4.77MHz IBM PC XT clone and a 10MHz PC AT clone and were surprised to see that they operated flawlessly at the highest data transfer rate. Borland also provides a remote file-manipulation program, 'TDRF', that you can operate from the debugging station to copy files between the machines, delete files on the target, create subdirectories on the target, and more.

Faster development through better debugging

A lot of program development is not so much how fast you can write code, but how fast you can get it converted into machine code. To that end, compiler writers have boosted the throughput of their compilers wherever possible. However, what's overlooked at times is that a significant part of developing a program is making sure the code you wrote works. It's no good having a fast compiler if you spend most of your time tracking down a bug rather than writing useful code.

The Turbo C and Turbo Pascal upgrades are significant as good debugging tools. The compilation speed improvements are minor. However, now you can single-step through source code statements with a keystroke and display a variable's contents in any format. With that type of debugging ability, the performance of these development languages has improved indeed.

The only surprise to TASM is that it took Borland so long to create it. It has everything you'd expect in an assembler, and it's faster than MASM. The documentation is loaded with interfacing details and probably makes the purchase price worth it.

On the other hand, the Turbo Debugger is a pleasure to use. Its ability to connect seamlessly with other Borland languages, along with its chameleon-like countenance — the capability to operate standalone, in virtual 80386 mode, or remotely — should put it high on any programmer's shopping list.

END



IZE

A program which organises your hard disk sounds too good to be true, but that's just one of the clever tricks IZE can do — if, like Ruth Wallsgrove, you're ready for it.

IZE aims to organise chaos: to summarise the contents of any file on your hard disk in an intelligent list of keywords. It can look for your keywords on its own, as long as the file looks like ASCII or is written in one of many word-processing programs. You can attach keywords to a file even if IZE can't read it. Alternatively, you can throw away your word-processing package, or use it through IZE to generate keywords as you create. It could be the answer to your prayers — if your prayers are fairly organised to begin with.

It must be said that IZE comes with the flashiest packaging ever seen by a micro: everything is coded with one of the four primary colour squares of its logo. Somebody at Persoft loves red, yellow and blue; well, I do too. The puns, on the other hand, are sheer torture for an Australian speaker: the installation guide is *Opening Your IZE*, the tutorial *FamiliarIZE*, and the corrections are — yes, *ApologIZE*. There are no prIZEs for surmIZE-ing what the reference manual is called (*Using your IZE*).

InitialIZE tells us that this product is based on the inventions (patents pending) of one man, Paul Kleinberger, and IZE was designed by him and Natan Blanks. Such individual creation has a good history: I suspect their particular model is Philippe Kahn of Borland, because IZE has that 'everything you can think of' cleverness of something like SideKick. However, Persoft is not Californian but hails from Madison, Wisconsin. It's distributed in Australia by MicroAustralia.

Installation

IZE runs on PC-compatible machines with at least 512k of RAM and a hard disk. The program currently comes on eight disks; the core files would fit on a 1.2Mbyte floppy disk, but wouldn't do anything very interesting. It comes with drivers for most common word-processing packages, Lotus 1-2-3, Harvard Project Manager, Hayes Smartcom 11, and various other kinds of software. It doesn't support several programs I need access to, including Framework, and my version can read ASCII files but not 'hot-link' to them, because it lacks the 'Generic ASCII' driver promised in the documentation.

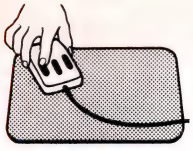
'The joy of playing with chocolate almost entirely wore off as I repeatedly hot-linked to no avail.'

Installing it is fairly straightforward — put in the first disk and type INSTALL. It warns you not to copy the files directly, not because it's copy-protected but because it writes itself programs with details of the software you've chosen and the appropriate drives and directories for it to find them. The first time through you have to do a full installation. Afterwards, you can just change your options for printer or other software, although even they are not exactly speedy.

The program will make an IZE directory on the hard disk, and will rewrite your CONFIG.SYS, if you let it. It does store your old one in case you need to amalgamate the two (for example, to tell your computer about a mouse for another package). This is a very new product, so we expect the information in the manuals not to correspond to the program: if you snootily decide to change your own CONFIG.SYS in the neat way suggested in the installation guide (using DOS COPY CON: command) you'll find you've set too few files and buffers and IZE will get snooty with you. (It requires 35 files and 25 buffers — somewhat more buffers than will be optimal for many other programs).

The installation is perhaps the least polished program in IZE: when it helpfully suggests F1, it tells you about everything but the thing you want help with (context-bloody-minded help?); elsewhere, F1 help is averagely sensitive. INSTALL also fails to tell you when it's

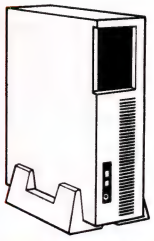
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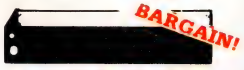
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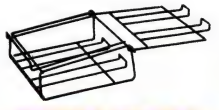
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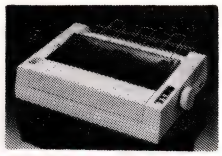
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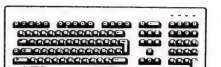
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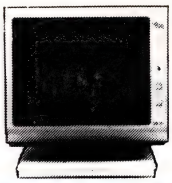


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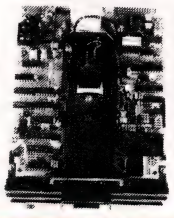
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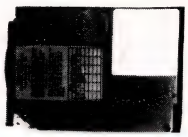
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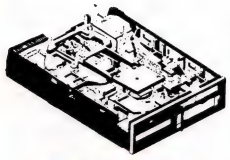
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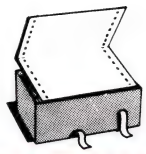
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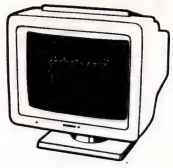


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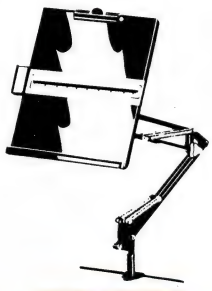


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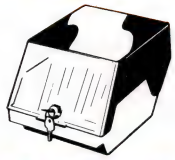
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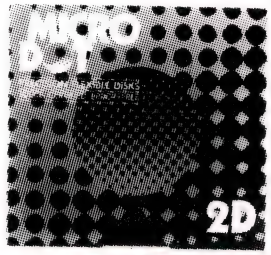
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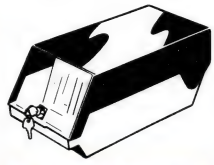
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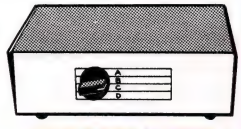
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M3043: TYPEWRITER EMULATION. Easier control of your printer with particular emphasis on printing directly from the computer in typewriter fashion. Suitable for envelopes, short letters, notes, labels, etc.

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GRAPHICS

M4006: EXTENDED FONT CHARACTERS. PC - FONT is a utility for Epson - compatible printers that will print all of the printable characters of MS-DOS character set - including block graphics, engineering and scientific, foreign languages, etc. Have solid underline and vertical lines. Gives more professional output.

M4007+: COMPUTER-AIDED DESIGN. Powerful control over drawing, graphics, printing and slide show. For easy creation and editing of graphics screens. Two disks. Key Draw. Also has CGA emulator for Hercules boards. A set of "clip art" drawings is now available on disk to accompany this program.

M4011: GRAPHICS ICON/CHARACTER CREATOR. Especially suits creation of symbols and logo-type characters. Contains Iconmaster.

M4012: TALK ILLUSTRATOR. "Present" is an easy-to-use program which provides special features for "slide" presentation. It will take snapshots of screens and combine them for automated presentation, allow you to combine comments with images, etc. For an example of its use see M1069.

LANGUAGES

M5001: FORTH. This is F83, the latest standard, with built-in editor, compiler, etc.

M5002: SMALL C. Ron Cains compiler for those interested in learning the C language. See also M5046.

M5014+: ARTIFICIAL INTELLIGENCE. These disks contain TWO Expert System Shells - ESIE and EXPERT. They help you to design a system that will gather information and make a recommendation. Two disks.

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M8028: DOCUMENTATION SYSTEM FOR DBASE2/3, CLIPPER, FOXBASE. Gives paths, program tree structure, lists files used, gives summary of variables, procedures, indexes, cross-references.

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M9008+: "C" TUTOR - A two disk set that contains a comprehensive and easily followed course in the "C" programming language. Includes tutorial text and source code for examples. Requires two drives. Suitable for those with prior experience in programming. If you don't already have a C compiler, we recommend M5046 to accompany this set.

M9017: DOS TIPS AND HINTS. Collection of advice on printing, creen, keyboard, colour, batching, booting, AT keyboard, etc.

M9022+: MODULAR2 TUTORIAL. 2 disks that teach you how to program in this important new language.

M9026: FRENCH TUTORIAL. Special attention to the conjugation of verbs.

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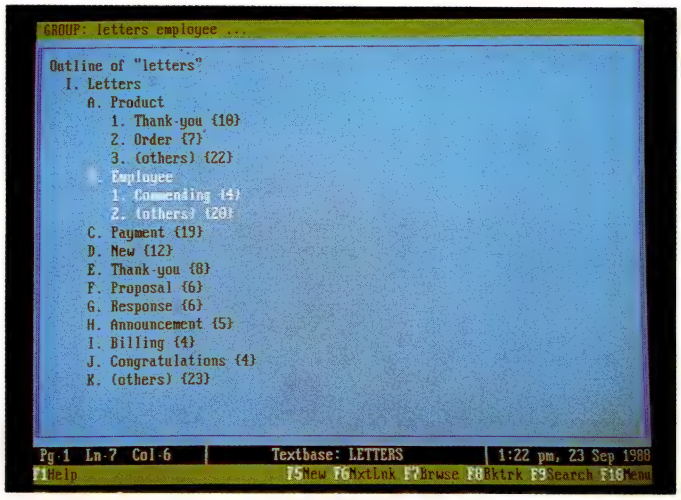
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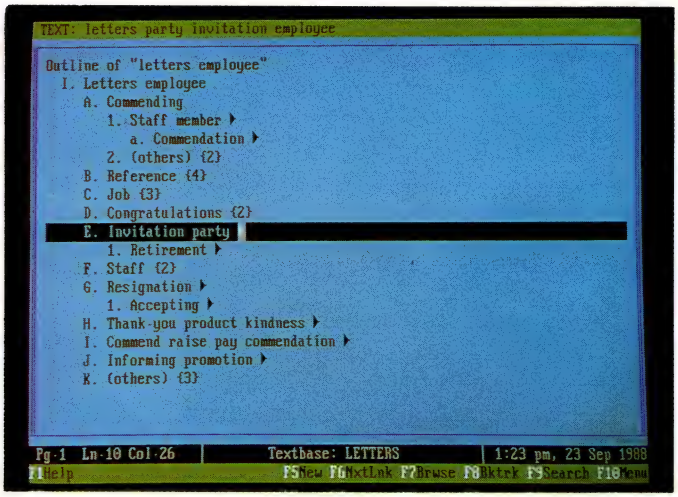
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IZE's outline mode features a fairly standard outline layout and user interface



The right arrow symbol indicates that a link to another area of the document exists

finished: here, as elsewhere in IZE, the only way you know you're through is that it stops asking you questions and returns to pointing at the option you originally chose. Actually, I was perfectly happy with this the first time around; it was just when I persistently got the message that the installation wasn't right while in the middle of trying to hot-link to other programs, that I began to find IZE irritatingly inscrutable.

In use

The interface to IZE will be familiar to most people who've seen more than one or two PC packages: it's as GEM-like as you get without a mouse, allowing you to choose either to go through pull-down menus or a series of keystrokes to perform most commands other than editing. (The series of keystrokes can be automated as macros very easily).

Editing relies heavily on the control key, WordStar-like but with more mnemonic keys; you would still want the reference card beside you to do any sophisticated cursor movements, however. Among other functions, IZE will let you both encrypt and lock IZE text. Locking or making a file read-only is useful for standard letters of documents that you would copy and unlock before customising, and such documents can then be filed very effectively with IZE.

To enjoy IZE, try the tutorial. It's not just that one of the tutorial 'text-bases' finds three major categories of food — fruit, vegetables and chocolate — but because IZE will never again seem quite as much fun as it does when playing. The clever idea behind IZE is that all the files in a textbase — basically, a collection made up of any kind of mixture of IZE-created texts, word-processed files and files from other supported software, in any directory you care to tell it about — can be viewed by keywords in organised lists.

For example, if you search for the keyword 'chocolate' in the food textbase, you get a list made up of all the texts indexed with chocolate in an 'outline', or hierarchy of categories. This looks very like the outline of one text as created in ThinkTank. IZE groups texts together and labels them by their other keywords, using the most key keywords to form indented groups. Note that it doesn't list them by filename: in this case, these texts are not in fact independently stored as files, but even an externally-created file would be treated as a piece of text accessed by its keywords rather than a name. 'Candy truffles' in the example below refers to one text, and moving the cursor to this line will allow you to get at that text by hitting F7:

Outline of Chocolate
I. Cake
A. Pie>
B. Candy truffles>
C. Fondue cherries bananas
fruits oranges>
II. Mousse>>
III. Candy apples>

You don't necessarily have to tell IZE about such a hierarchy: in the absence of any other instruction, it works it out for itself each time, depending on the keyword or keywords for which you have searched.

The search in itself is quite smart. It will outline all the texts and files in a textbase if you don't enter any word at the search. It can perform 'fuzzy searches', giving you all available keywords that almost match if you prefix a search word with an '&'; you can then delete any words that aren't suitable before it actually does the search. It can also do Boolean searches, any combination of keywords linked with AND, OR or NOT, and brackets to avoid ambiguity; and you can define keyword filters to search for different keywords that mean the same thing, or to tell it that some 'key' words are actually irrelevant. The texts or files that are found are then assembled in an outline. If you don't provide a 'guideline' it will assess the importance of a keyword by its frequency.

In this example, 'cake' appears as a category rather than an instance, because 'cake' is a keyword for more texts than 'pie' is. Categories and subcategories also appear in order of frequency, so that the most common ones are at the top of the outline. You can tell from this outline that there are three texts that mention cake as well as chocolate and at least one other keyword (for example, pie) because there is just one arrow for each of the three subcategories.

However, there are two texts mentioning chocolate and mousse (but no other keyword) since mousse has two arrows. Here you can see that every piece of text or file is not necessarily listed separately in an outline, although you can get at one of them by placing the cursor under one of the arrows. The keywording isn't sufficient to distinguish between them, but you can easily browse through until you find the one you want.

IZE allows you to toggle between the two texts most recently accessed, and keeps all the texts you have altered —

Software currently supported by IZE

Hot-links — IZE provides drivers for the following:
ACT!
Brief v1.3
Dan Bricklin's Demo II
Dan Bricklin's Demo
DisplayWrite 2 & 3 (TXT)
DisplayWrite 4
Epsilon
Final Word II v2.2
Harvard Total Project Manager II
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IBM Professional Editor
Lotus 1-2-3 v1A
Lotus 1-2-3 v2.0
Manuscript v1.0
Microsoft Windows v1.0
Microsoft Word v4.0
Multimate v3.6
Norton Editor v1.3
Office Writer v5.0
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SmarTerm 240 v2.0
SmartMove v1.0
Symphony v1.2
ThinkTank v2.0
Volkswriter Deluxe v2.0
WordPerfect v4.2
WordStar 2000 Release 3
WordStar v3.3
WordStar v4.0
XyWrite v3.0

Import conversions — IZE provides programs to convert IZE format:
DCA/RFT
DisplayWrite 2 & 3
Microsoft Word
Multimate
Samna Word
WordPerfect
WordStar v4.0
WordStar 2000

and the 10 most recent unaltered texts — in its 'workspace' for quick retrieval. It saves this workspace when you exit IZE. Texts or files can't appear twice in an outline, so there can be no cross-referencing at this point; 'candy' could be a category of its own, with two texts, but isn't because one is taken away by 'cake'.

It is probably not hard to see that this could give you an outline that didn't correspond at all to your order of priorities, if you hadn't been well ordered when you assigned keywords, or if you hadn't controlled the ordering of the outlines with guidelines or keyword filters. The tutorial is fun, but sorting out your own thoughts is, as ever, bound to be more hard work.

Keywords

You can assign keywords in various ways. You can mark a word as you write, either in IZE itself or using your own package through IZE, if IZE can support it. You can assign a predefined set of keywords — a 'keychanger' — to a text when you save it, when you import it into IZE, or to any group of texts or files collected in an outline. You can change the keywords by hand at any time in an IZE text or in a 'summary text', the way IZE records the details of an external file.

A file can have a set of keywords associated with it even if IZE cannot decipher a single word of the file, though in this case it obviously can't look for keywords inside the file. The mechanics of adding and changing keywords are adequate for any task I could think of, and the IZE manual does try to advise you on how to make sensible use of these.

Obviously it isn't magic: you have to work out how to classify your text or files, and one way or another you have to add the appropriate keywords and, possibly, guidelines and filters so that IZE can give you meaningful outlines of all you want summarised together in a textbase. In addition to the manual's suggestions — to whom a letter was written, the address of a client, an employee's salary, and so on — and the date and time stamping of the file, I'd suggest adding the file's name as a keyword if, like me, you've had to evolve a sensible naming convention before IZE came along.

IZE can make sense of the files you've already written in many other packages, without importing them into the IZE format — importing is not particularly well supported, and I'm not convinced IZE makes an adequate substitute for a full-feature word processor such as WordPerfect. It won't support proportionally spaced fonts, for example. It is also limited to individual texts of up to 32k (about 12 pages of A4) although it's easy enough to make up and manage longer documents in 'text base' format. I used it to run my old WordStar to write this

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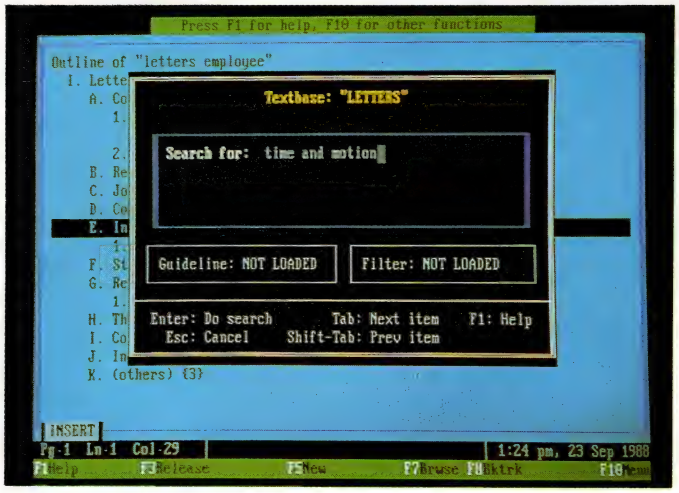
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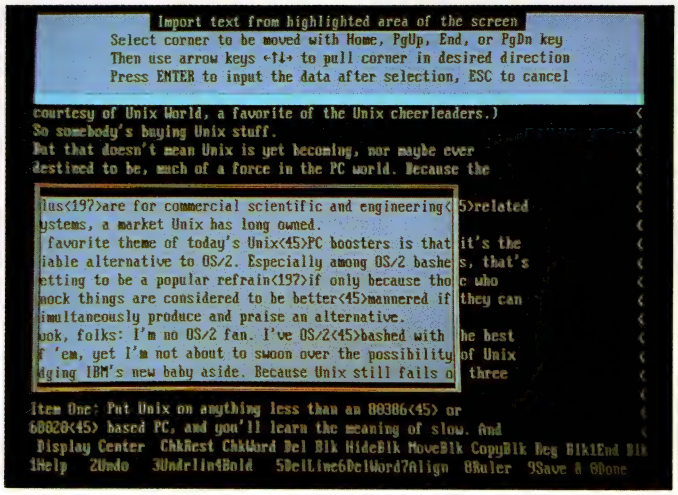
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IZE retrieves data simply. It will filter out all the entries which don't contain the search criteria



In resident mode, IZE can grab screens of text information from virtually any text-based package, in this case WordStar

review, in preference to editing in IZE, but I'll say more about that later.

You can 'hot-link' to external files in three ways. Firstly, you can create a new file in, say, WordStar 3.3 by pulling down the Text menu and choosing the 'Create Hot Link' option. This gives you a summary text (into which you can type your own summary and/or keywords), instructions for marking keywords and popping up the keyword box if the usual IZE F4 and Alt-F4 keys are not free to be used in your package, and the option to access the file. Choosing this option — by positioning the cursor under the diamond — gets you into your package and file. If IZE can do it, you can mark words as you write or edit, but this is not possible with some common packages such as Microsoft Word or Lotus 1-2-3.

When you have a summary text for your file, you can call your file up on its proper package at any time by selecting its summary text from an outline — *any* outline in which it appears. I found IZE is a bit slow getting into and out of other packages, or branching to DOS — but then I use slow machines. As far as I could tell, you have to go back into IZE to make a summary text for a new file — it doesn't automatically start one when you create a new file in the external package. In fact, when I tried, it added any keywords I marked into the keyword box of the last file — not very friendly.

The third way to link is to select 'Hot Linked Import' from the File menu: this creates a summary text for every file you select, again with any keywords from a selected keychanger automatically added or ready to add, if IZE finds them in the text of the files themselves.

Dealing with other programs

Can IZE deal with your favourite programs? The answer is that it can do something with them, but how much depends on several things. Files from some packages can be imported, or converted to IZE format — basically, only from recent and common word-processing packages. However, drivers to run any package can be constructed, with plenty of help from the *UtilIZE* manual, and many are provided.

'Apart from their names, the IZE manuals are pretty good. The writing is clear, indexes as good as any, and the colour coding is cheerful.'

If it's possible (and it's not possible if your package uses a graphics rather than text screen mode) these drivers allow you to also mark keywords (for IZE's eyes only) and to use a keychanger to look for designated words in the text to add to the file's keyword box (which is also kept only with the IZE summary text).

Actually, I suspect that controlling keywords through the keyword box, or even the summary text if your package won't allow IZE to pop up the box, may be a good idea. I've spent too much time helping people design appropriate indexes not to get nervous with keywords: choosing up to 300 per file might seem like fun, but remember that IZE will decide what the major categories are by frequency of keyword unless you do the work of categorisation.

If you mark a trivial keyword in lots of files, IZE will use it in preference to a more substantial but less frequent category, and your outlines will look silly. You can tell IZE to ignore it or delete it as a keyword, but you'll probably wish you thought about your own real categories before you chose them with IZE.

As I have said, I used IZE as a front-end to WordStar 3.3 to write this review, having written obvious keywords (IZE, APC, REVIEW) in its summary text. I dated but did not time stamp it (I never worry about the time of a file, but IZE is bossy about this and makes you set the time if you don't have a clock), and added its filenames to the keyword box.

I have too many WordStar files to change them to IZE, or any other package for that matter, but there's another reason I won't be using IZE to create files very often. I move around a lot, using PCs where I can during my working day (and to get at laser printers with work written at home). Sometimes all I can use are dual floppy drive machines, or the machine's owner doesn't care for me installing software on their hard disk. So, for the moment, I'll stick with packages on one 360k floppy disk which will let me get in and out of them quickly. IZE is clever, but it's also very big.

Doubtless it's WordStar's fault, but I did have trouble with my files; even when the hot-link works, IZE can't seem to pass the filename in a way WordStar understands. IZE can still get at the right file, however. Also, on two PCs, I couldn't get IZE to do the fast Hot Link Import at all. It complained that the con-

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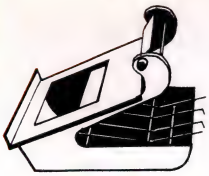
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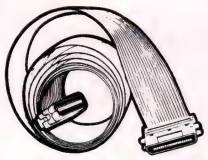
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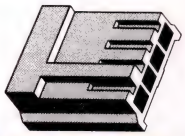


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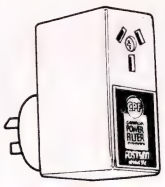
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9S	$0.70	$0.60	$0.50
9C	$0.60	$0.50	$0.40
15P	$0.70	$0.65	$0.60
15S	$0.70	$0.65	$0.60
15C	$0.70	$0.60	$0.50
25P	$0.70	$0.60	$0.50
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20 WAY			Cat. W12620
$2.50	$2.20	$2.00	
24 WAY			Cat. W12624
$2.90	$2.70	$2.60	
25 WAY			Cat. W12625
$3.20	$2.90	$2.70	
26 WAY			Cat. W12626
$3.60	$3.10	$2.90	
34 WAY			Cat. W12634
$3.90	$3.60	$3.40	
36 WAY			Cat. W12636
$3.90	$3.60	$3.40	
40 WAY			Cat. W12640
$4.90	$4.40	$4.20	
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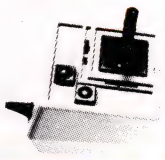
The CPF provides protection from dangerous electrical spikes that can cause anything from obvious damage (like immediate equipment failure) to less obvious harm that can drastically shorten a system's life.

CPF's superior circuitry design and semi conductor technology responds instantly to any potentially damaging over-voltage, ensuring safe trouble free operation.

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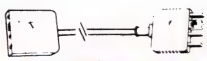
SPECIFICATIONS:
Electrical rating: 220-260 volts (AC) 50Hz 10 Amp
Spike/RFI Protection: 4,500A for 20m/second pulses.
Max clamping voltage: 275V differential mode.
Cat.X10088 **$69.95**





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- Length 10 metres

Cat. Y16024 **$7.95**

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- U.S. plug to 2 U.S. sockets
- Length 10 metres

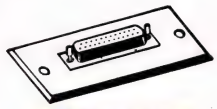
Cat. Y16028 **$9.95**



DB25 PLUG WALL PLATE

- Fitted with DB25P plug. (RS232)
- Anodised aluminium plate.
- Includes mounting hardware.

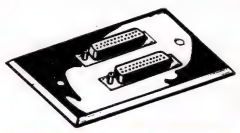
P10944 **$11.95**



DB25 SOCKET WALL PLATE

- Fitted with DB25S socket. (RS232)
- Anodised aluminium plate.
- Includes mounting hardware.

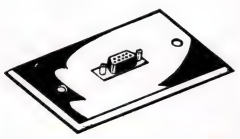
P10947 **$11.95**



DUAL DB25 SOCKET WALL PLATE

- Fitted with 2 x DB25S sockets. (RS232)
- Anodised aluminium plate.
- Includes mounting hardware.

P10948 **$19.95**



DB9 WALL PLATE

- Fitted with DB9S (9 way 'D' connector socket.
- Anodised aluminium plate.
- Includes mounting hardware.

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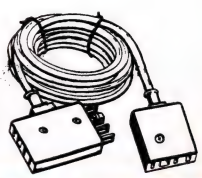
Cat. Y16023 **$6.95**



TELEPHONE ADAPTOR

- Australian plug to U.S. socket
- Length 10cm

Cat. Y16026 **$5.95**



TELECOMMUNICATIONS AUSTRALIAN STYLE ADAPTOR CABLE

- Australian socket to plug/socket
- Length 10 metres

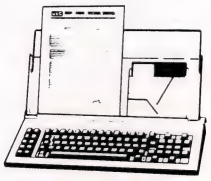
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- Mouse resident firmware
- Auto repeat key
- 1·5 metre lead
- DB25 socket connector
- Weight: 212 grams
- Size: 116 x 66 x 34mm
- Mouse Driver Software included, allowing you to install with all popular software packages. Also included is the handy Pop-Up menu software that allows the user to integrate the mouse with the keyboard, DOS, and other popular software packages including D-Base, Framework, Lotus, Symphony, Wordstar and others.

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KEYBOARD DUST COVER & COPY HOLDER

- Combines two functions in one set.
- Flexible clamp can be attached to most brands of keyboards
- Made of clear acrylic plastic.
- Overall size: 449 x 180mm

C21064 **$29.95**

KEYBOARD COVERS

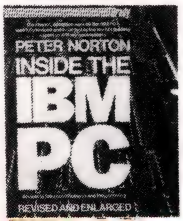
SIZE	CAT.No.	PRICE
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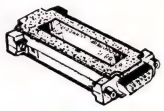


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The widely acclaimed guide to the IBM PC's inner workings. The latest edition now covers every model of the IBM micro: PC, XT and AT, and every version of DOS from 1.1 to 3.0

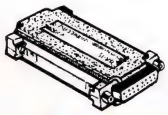
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DB9 GENDER CHANGERS

- Saves modifying or replacing non-mating DB9 connections
- All 9 pins wired straight through

X15640: **Male to male**
X15641: **Male to Female**
X15642: **Female to Female**
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DB15 GENDER CHANGERS

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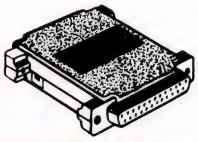
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RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

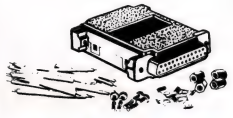
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Cat.X15651 **Male to Female**
Cat.X15652 **Female to Female**
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Only $9.95ea



RS232C NULL MODEM ADAPTOR

- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

Cat.X15657 **Male to Male**
Cat.X15658 **Male to Female**
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RS232 MINI JUMPER PATCH BOXES

- Interface RS232 devices
- 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

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- 25 pin "D" plug to 25 pin D" socket
- DIP switches allow easy switching of internal wiring.

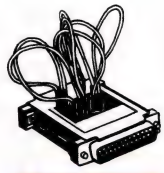
Cat. X15662 **$32.95**



CENTRONICS GENDER CHANGERS

- Female to Female.
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through.

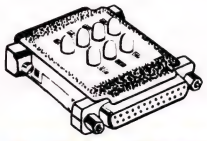
Cat.X15663 **Male to Male**
Cat.X15661 **Male to Female**
Cat.X15664 **Female to Female**
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RS232 WIRING ADAPTOR BOX

- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat. X15665 **Normally $49.95**
Only $44.95



RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

Cat.X15656 **Normally $39.95**
Only $29.95



RS232 SURGE PROTECTOR

- Avoids costly damage from large voltage peaks caused by lightning or other power problems
- Uses metal oxide varistors (M.O.V.) to suppress any voltage above 26V on pins 2,3 and 7.
- Will handle up to 1 Joule and 250A peak current.

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It only takes a minute amount of dust, dirt or magnetic oxide particles on your drive heads to cause problems: errors, downtime or an expensive service call. Regular use of a head cleaner will keep your drive free of trouble causing dirt and help keep your system up and running. These disk cleaners are simple to use, and include cleaning solution and instructions.

CAT.No.	SIZE	PRICE
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STAR NX1000 PRINTER

- 144 c.p.s. high speed draft printing
- 36 c.p.s. NLQ printing
- 8 built-in NLQ fonts
- Proportional printing available in all font styles
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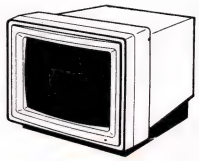
FEATURES....
- High contrast, non-glare screen
- High resolution, 80 or 40 character display

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green or Amber
Video input signal: Composite Signal
Polarity: Negative Sync.
Level: 0·5V-2·0Vp-p
Scanning frequency:
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Display character: 80 characters x 25 rows.
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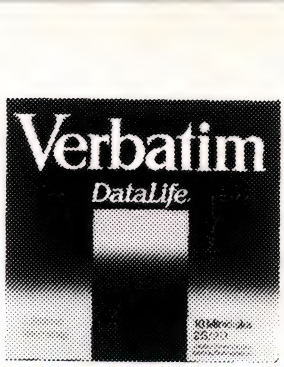
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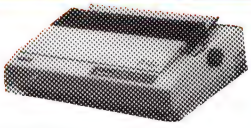
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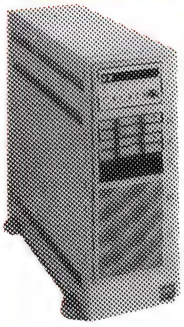


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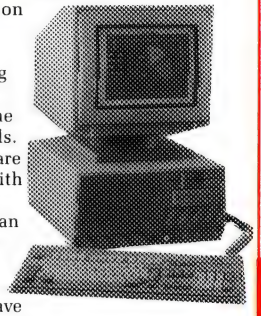
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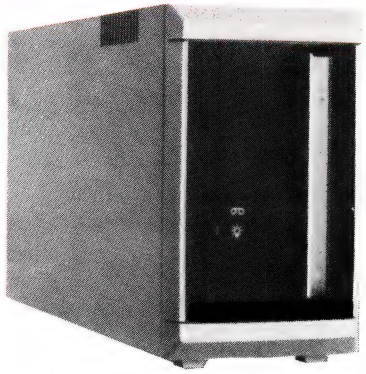
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version programs weren't working, either because they hadn't been installed properly or because of memory or disk space limitations. Both machines had plenty of free RAM and more than 1Mbyte of disk space — and certainly no less than on the PC where I finally got it working. And if, during installation, it understood well enough that you want to access WordStar 3.3 or Multimate or WordPerfect to offer them on a menu, it ought not to complain that it can't find the conversion programs for them. The joy of playing with chocolate almost entirely wore off as I repeatedly hot-linked to no avail.

Documentation

Apart from their names, the IZE manuals are pretty good. The writing is clear, indexes as good as any, and the colour coding is cheerful. The documentation is not as finished as it looks, but then IZE is a young product and nothing is actually misleading if you look at *ApologIZE* and the file READ.ME (not copied onto the hard disk at installation, but present on the Program 1 disk) at some point. I enjoyed the tutorial (in the manual *FamiliarIZE*) and I can't remember feeling that about many packages. And I approve of solidly constructed Quick Start and Reference cards (the latter a riot of coloured boxes, again).

Conclusion

The idea of a textbase — a database of free text — is very appealing, even fashionable. IZE will let you create any one you want, with plenty of functions and help — especially if you keep the manuals beside you. It doesn't have advanced word processing functions, but it can be used on its own, especially if you're likely to want all your documents in small chunks. At $771 it's not cheap, but it's great value.

My main reservation is that all its functionality won't help you if you're basically disorganised. It could become indispensable to a busy office, but only if the organisation of files is already there, or somebody takes time to think the organisation through. The sort of people who can keep files in order — who, for example, already have their floppy disks filed by date and document type — could make full use of IZE. But they, unfortunately, are not the people who need it most.

END

IZE costs $771 and is available from MicroAustralia, tel: (02) 736 3299.

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Presentation Manager and LAN Manager

A graphical interface and network support carry OS/2 well beyond the traditional DOS environment. Steve Apiki and Stanford Diehl look at two programs which represent a new direction in operating-system design.

All the pieces are starting to fall into place for OS/2, and the nearly-completed system is beginning to look pretty impressive. In addition to the primary benefits of multi-tasking and seemingly limitless program memory, the Standard and Extended Edition 1.1 versions of OS/2 offer features that enhance usability, add functionality, and even point to a new standard for both user and programmer interfaces.

One of the most eagerly-awaited features of DOS's heir apparent is the Presentation Manager, a graphical user interface scheduled to be included with Standard Edition 1.1 and released within the next couple of months.

The LAN Manager, slated for release with Extended Edition 1.1, adds network support to the communications and database management capability of the current Extended Edition.

Together, the two programs represent a new direction in operating-system design: tight integration of a consistent user interface with functions currently found only in applications packages.

Presentation Manager

The phrase most often used to describe the Presentation Manager is 'Windows-like', but the comparison is understated. From the user's point of view, the Presentation Manager *is* Windows, except now you're working on the system level and can access both applications programs and the operating system itself.

Users familiar with either Windows or the Macintosh should have no trouble getting up to speed with the Presentation Manager's point-and-click interface.

The Presentation Manager is actually a shell program that can be enabled or disabled using the PROTSHELL command in the OS/2 CONFIG.SYS file. With Standard Edition 1.1, you have the option of using either the standard OS/2 interface or the Presentation Manager.

At boot-up, you're presented with two windows: the Task Manager and the Start Programs window. These are special operating-system windows that control the session and cannot be removed. Together, these windows replace the Session Manager found in the original incarnation of OS/2, although that is an oversimplification — the Start Programs window allows you to begin new tasks, and the Task Manager allows you to switch between them.

Within the Start Programs window is a list of tasks that can be started by pointing and double-clicking with the mouse or by choosing Start from the Program submenu on the menu bar. Two task choices are always in the main list: OS/2 Command Prompt and OS/2 Windowed Command Prompt. Selecting these lets you enter commands at the DOS-like [C:] prompt, either in full-screen mode or within a window.

You can also select DOS Command Prompt to work in the DOS compatibility mode, but, as always, you are limited to one real-mode session. Adding programs to the list in the window is as easy as bringing up a dialogue box and specifying a name and a path to an OS/2 executable file. Tasks can be grouped in

the Start Programs window, and you can switch easily from group to group.

The task list also contains two system control programs: the PM Control Panel and the PM Filing System. The Control Panel gives the user control over system parameters, such as port configurations, screen colours, fonts, and country information (such as currency, date formatting, and numbering conventions). Choosing the Filing System brings up a powerful file-management facility: it allows you to navigate through a directory tree, moving, copying, and deleting files — and subdirectories — using just the mouse. You can group files by association, change file attributes (read-only protection, archive status), and sort files using the Filing System.

The Task Manager contains only tasks that are currently running. Switching between active tasks can be done through this window or by selecting the task window with the mouse. You can also close or terminate active-task windows. The menu bar for the Task Manager offers other commands that can be used to shut down the system or to arrange windows on the screen. The shut-down choice can be used to save currently active tasks so that they will restart on boot-up. The file information is simply saved in START-UP.CMD.

The role of the API

Using applications in the Presentation Manager may be simple and intuitive, but writing them is a very different story. Programmers with Windows experience, like users, will feel much more at home than those used to the plain vanilla DOS environment. Even application developers just getting comfortable with OS/2 kernel programming will have to throw out much of what they know to work within the Presentation Manager shell. Of course, programs using the OS/2 kernel functions for I/O (functions beginning with the VIO, KBD and MOU prefixes) should run from a windowed command prompt with no adjustments, but they will not take advantage of the Presentation Manager's consistent graphical interface.

Application programs are insulated from direct contact with users by the Presentation Manager's Application Program Interface. The API is the underside of the Presentation Manager, providing all applications with a consistent interface in the same way that the upper side provides a consistent interface to the user. From the program's point of view, there are only three kinds of output and one kind of input. The application can write either text, graphics, or dialogue information to a presentation space. The presentation space can be associated with devices (screen, printers, etc.) by the application. Input to the program comes from one source only: a message queue where the API posts messages to the program about user actions.



Presentation Manager's graphical interface provides user-friendly multi-tasking

Four different types of devices can be associated with a presentation space. There are screen, memory, metafile, and device contexts, which allow you to access output hardware without resorting to application-specific device drivers. Of course, the screen is used for almost all program output, but sending data to a printer can be done using the same screen-display code; the application merely needs to associate the presentation space with a different device context. While graphics and text can be written to any device, dialogue information (which creates an interactive dialogue box) can be written only to the screen display.

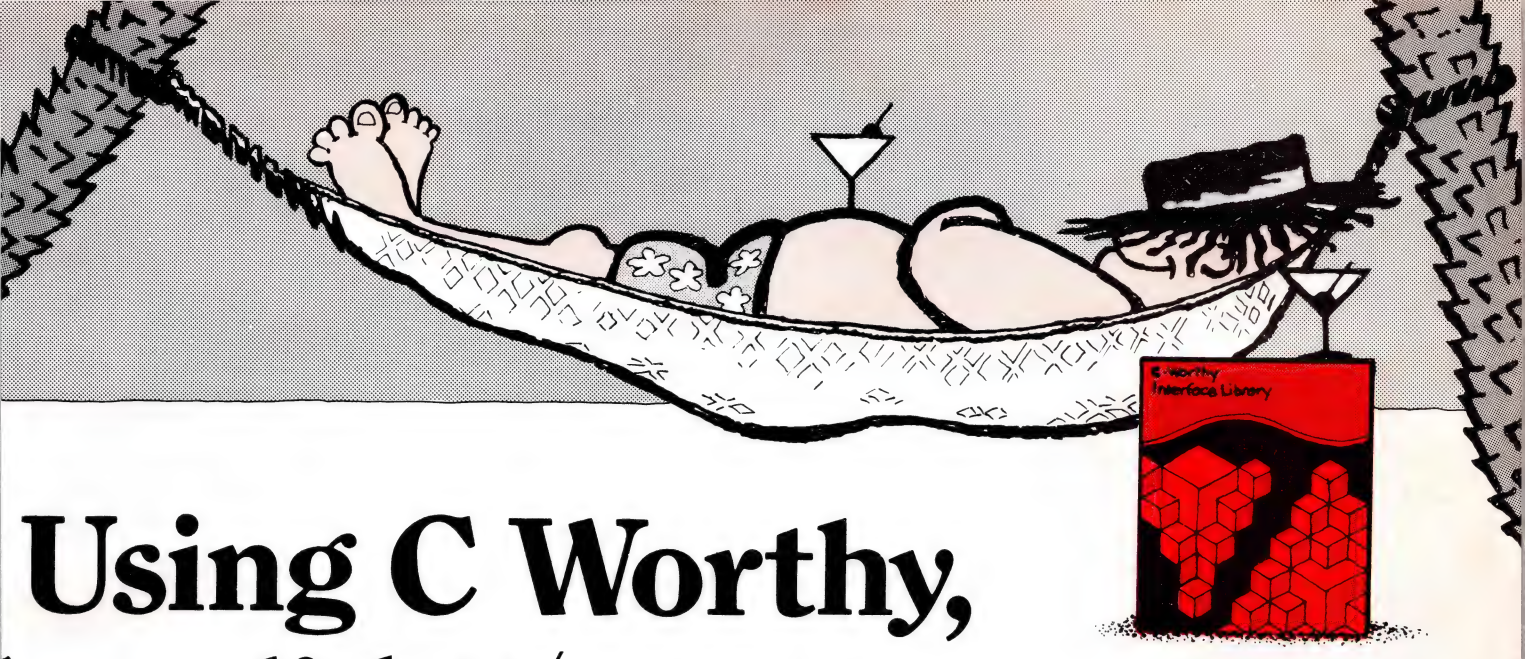
All program input comes through the message queue. Each window on the screen has its own queue, which contains information specific to that window. For example, when the user resizes a window using the mouse, the Presentation Manager posts a message in the window's queue informing it that its frame has been resized and it must update its display. Similar messages are posted when the window is moved, minimised (reduced to a bit-map icon), or terminated. Messages are processed by the application in sequential order. Windows can also send messages to each other; a good example is a scroll-bar window relaying user-selection information to the window containing the text to be scrolled.

The message-based software architecture makes writing Presentation Manager applications very much like writing applications for Windows. A Presentation Manager application must begin by registering a window class and drawing a window. Next, it must create a message queue for itself. Most of the application's time is spent in a simple message-processing loop like the following:

```
while (WinGetMsg(hab,msg,
    filter,first,last))
WinDispatchMsg(hab,msg);
```

A quit message in the queue causes WinGetMsg to return a value of 0, dropping the program out of the loop. Any other message is processed by a window procedure, the real meat of the application. The window procedure is generally built around a structure like the C switch statement, where each message is handled by its own section of code.

What allows these programs to be written in a high-level language at all, is a huge assortment of standard functions and definitions, provided only (for now) by Microsoft's Software Development Kit. The functions, though readily identified (WinEnableWindowUpdate), will take any non-Windows programmer a while to become comfortable with. The



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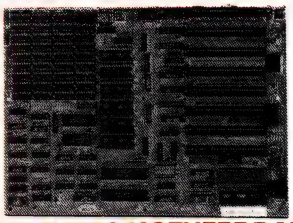
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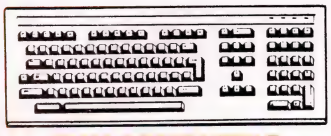
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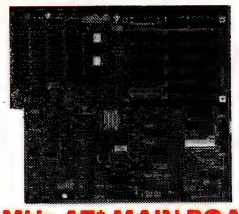


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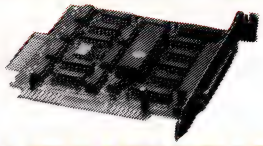
- Serial port
- Parallel port
- Games port
- Clock/Calendar with battery back-up
- provision for second serial port

Cat. X18050 **$194**

MULTI SERIAL CARD

- 4 RS232C asynchronous communication serial ports. One fitted 3 optional.
- NS16450 Asynchronous communication elements (ACE)
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- Interactive installation procedure available.

X18154 **$139**



16 BIT FLOPPY DISK DRIVE CONTROLLER CARD

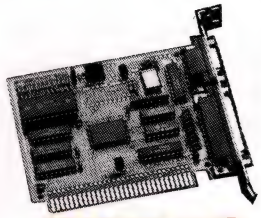
These cards will control up to 2 or 4 double sided 360K IBM* compatible disk drives.

X18005 (2 Drives)...**$52**
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- 2K-Static RAM, 64K Dynamic RAM
- Display Mode: 720 dots x 348 lines

Cat. X18003 **$139**

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Cat. X18002 **$99**

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Text Mode: 40 columns x 25 rows.
Graphics: 320 x 200
Monochrome:
Text Mode: 80 columns x 25 rows.
Graphics: 640 x 200

Cat. X18010 **$99**

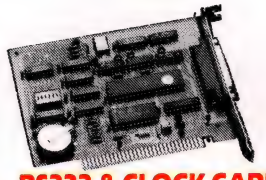
PRINTER CARD

This card features a parallel interface for Centronics printers. Included is printer data port, printer control port, and printer status port.

Cat. X18017 **$29**

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Cat. X18028 **$89**

RS232 (SERIAL) CARD
(WITHOUT CABLE)

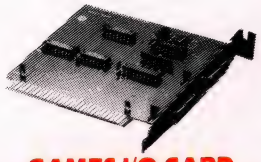
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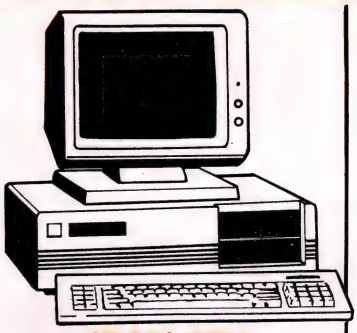
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- User selectable from 64K to 512K
- DIP switches to start address

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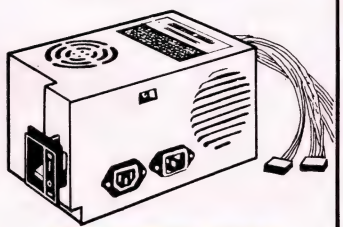
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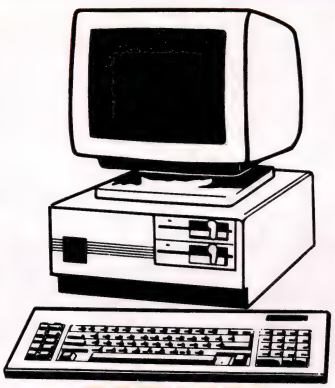
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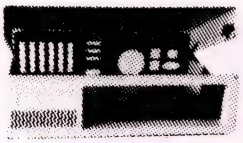


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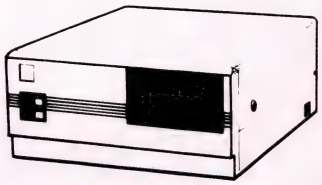
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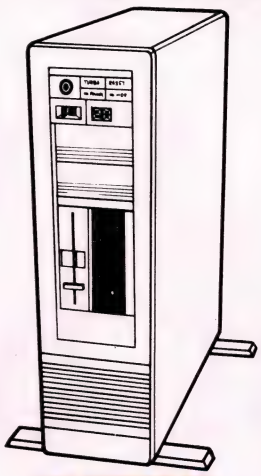
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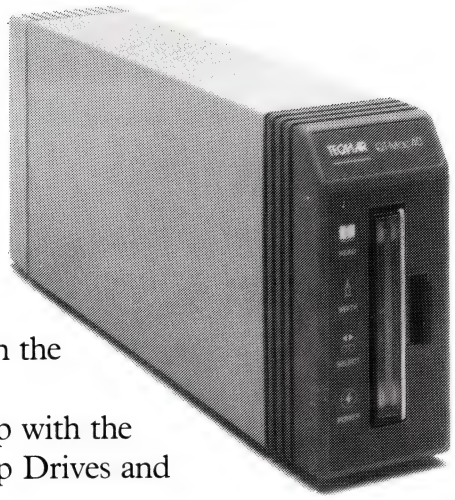
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header files and the window-handling routines also add a high overhead to any program; the source code for a Presentation Manager 'Hello World' program can be 3.2k long, and even a carefully linked 'Hello' executable can be over 11k.

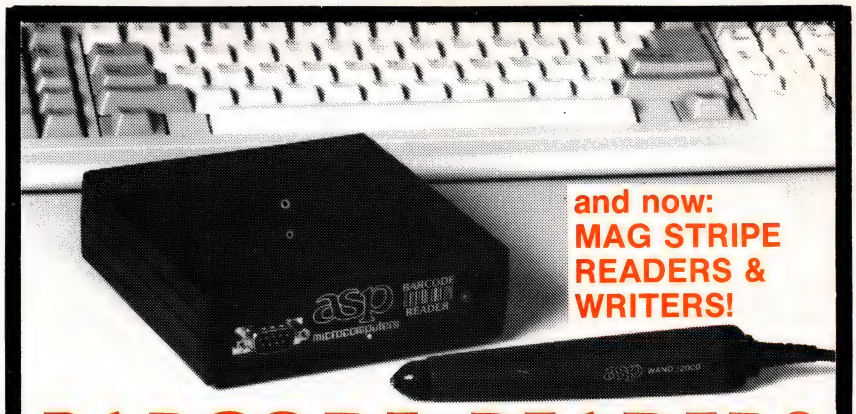
LAN Manager: the missing link

Certainly, the release of the Presentation Manager is a major step in the development of IBM's Systems Application Architecture (SAA). The ultimate goal is a standardised interface for both user and programmer, from application to application and from machine to machine. Helping to reach that goal are powerful operating-system utilities that behave toward the user like any other application. The latest of these is the LAN Manager, another key piece to the OS/2 puzzle.

While the Presentation Manager links OS/2 to the user, the LAN Manager aspires to a loftier goal: to link users to each other. Touting the promise of multitasking and transparent resource sharing, OS/2 stalks a domain once considered the exclusive province of powerful mainframe computers. Personal computers already pack the hardware punch necessary to meet the challenge; only the software gap holds them back. For the most part, the computer community shares the OS/2 vision. We only disagree on which standard will emerge. Now, finally, Microsoft lays its cards on the table.

The LAN Manager offers an interface much like the Presentation Manager's, with a system of hierarchical menus forming the user interface and the underlying API interfacing with OS/2. The user interface breaks down into four parts: the View menu, the Message menu, the Config menu, and the Status menu. The administrator can also access a fifth menu for system maintenance. A separate interface for console servers uses the same menu structure with options limited to sending messages and monitoring activity.

The user can also drive the LAN Manager directly from the command line. This not only allows batch files to automate command sequences, but it also ensures compatibility with other PC networking products such as PC-NET and MS-NET. Microsoft, again, tries not to leave DOS behind in its grand scheme of connectivity. The LAN Manager runs in protected mode when linking to shared resources. But once connected, it can switch to the DOS environment to run MS-DOS applications.



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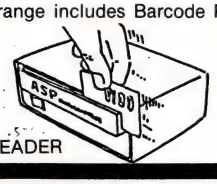
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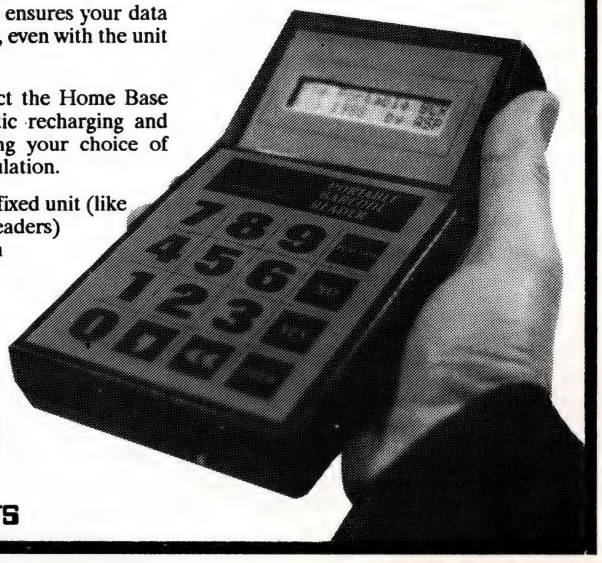
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While the user clicks through the friendly menus, the API churns away beneath the surface. In fact, many times the user won't even realise just how hard the API works. The API persistently strives for the dual goal of smooth operation and total transparency. If the user tries to send a message before loading the messenger module, the API loads it. Or suppose the user tries to access a remote disk without first connecting to the server. The LAN Manager will automatically start a session to the server, issue a Net Use command to access the shared disk, validate user-access level by submitting the user name and password specified at network start time, and then proceed with the user's original request.

The user, meanwhile, sees only the response to the original request, completely oblivious to the API's work. The API will even try to re-establish a disconnected session if the user issues a command after losing the link.

DOS workstations also benefit from this intuitive interface. Workstations running Microsoft Networks version 1 or 2 cannot specify a user name or a group name — a necessary input to the LAN Manager servers running in user-level security mode. However, when the server receives the request from a DOS workstation, it automatically issues a guest user account, complete with permissions and passwords. If this account conforms to the access level requested, the LAN Manager makes the connection.

Share and share alike

Whether it be messages or files or physical devices, a LAN's principle purpose is to let users share common resources. As a LAN Manager administrator, you decide who shares which resources, as well as when and how they are shared. Using the Add Share command button from within the View menu, the administrator can select the resource to be shared, assign a share name, designate a drive and path if necessary, limit the amount of users who can access the resource, issue a password, and determine how the resource can be used.

In the case of shared printers or communications devices, the LAN Manager establishes a queue to route requests through the network. The administrator can add, delete and reconfigure the queue, thereby retaining complete control over system requests and device access. The administrator can also establish pools of devices and route jobs to the first available device in the pool. The identical priority levels are processed FIFO (first in, first out). Requests within a queue can be scheduled for a specified time or date.



LAN Manager's menu structure makes it easy to set system parameters

The network also shares disk space. The administrator can designate entire directories (to include subdirectories) for sharing or limit access to specific files. For added security, the administrator can determine which functions each user can perform. Even though a number of users may be able to access a directory on the shared disk, some of them may only be able to write files to the directory while others can delete files or change file attributes.

In addition to reading and writing files, the user, with proper permission from the administrator, can execute remote programs in server memory. In one swoop, the user shares a disk, a program, and even memory from the server. Updated files are left in the shared directory for other users in a group to access or modify.

The LAN Manager also includes a messenger service so users can send and receive messages across the network. The administrator can send messages to a group of users or to every user on the network. Each workstation is assigned a message name, and messages are usually routed via the message name, although you may also tag a message for a specific workstation or server by designating its computer name. A Pop Up option enables immediate display of a received message. The message will flash in the message box at the receiving workstation. Although the LAN Manager does not currently include a text editor for message composition, the message service will transmit files as well as short notes, so the user can compose a message on any word processor and relay the file across the network. If you wish, you can have your messages automatically stored in your message log.

Although further enhancements to the LAN Manager and the Presentation Manager will surely follow, the basic pieces of OS/2 are in place. The concept is grand, the structure inclusive, but the verdict is in the hands of the users, who must see if these final pieces of OS/2 fit into the real world.

END

'Whether it be messages or files or physical devices, a LAN's principle purpose is to let users share common resources.'

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Presentation graphics programs have put artistic tools at our fingertips, spoiling us with clip art, 3-D effects, drop shadows and a wealth of features that show off our data in ways Lotus 1-2-3 never could.

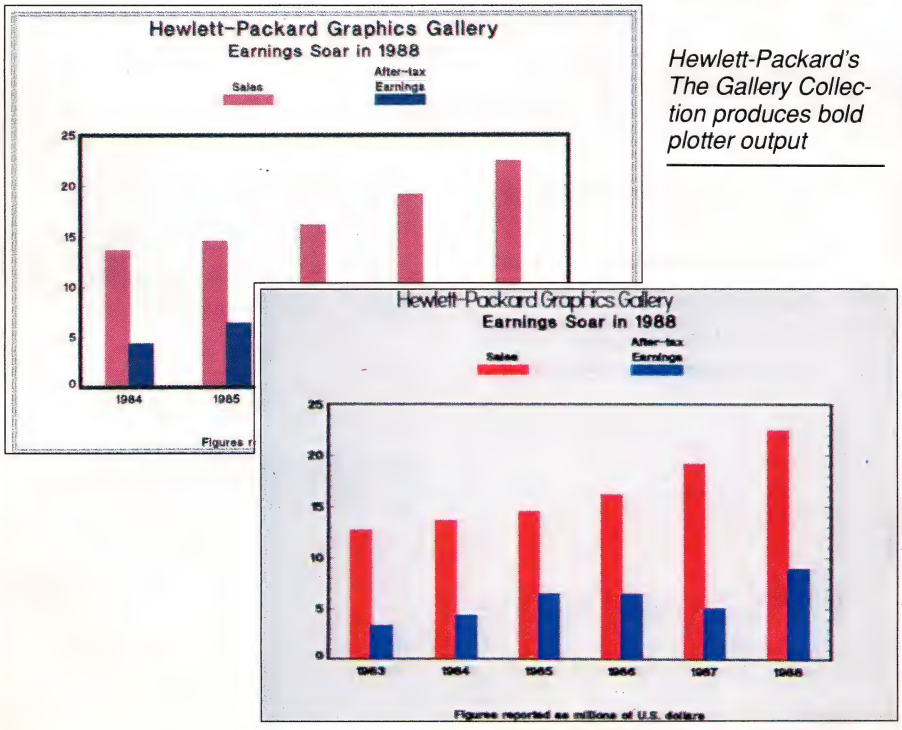
Not only do they add visual interest to statistical stories, they liberate our graphs from shades of grey on dot matrix output. What distinguishes presentation software from simple charting software is its ability to drive a host of devices — from PostScript printers to 4000-line film recorders — that apply a clean, crisp, executive image to the stories we have to tell.

The eight products reviewed here are what we call desktop solutions to presentation graphics. They are geared to the business office: to the manager who wants more from his graphics than elementary line drawings and crude bar charts; to the administrative assistant who wants to dress up a report with visuals that emphasise a point.

These are programs with easy installation routines and relatively short learning curves. Programs that can be used by those in business with relatively little hassle. Programs that demand only the smallest aesthetic commitment from their users.

Nevertheless, the software packages reviewed here are chock-full of easy-to-use artistic elements. Their clip art libraries and freehand-drawing features may not make Leonardo da Vincis of us all, but they can bring smiles to the faces of those who view our presentations.

C Ellison



Hewlett-Packard's The Gallery Collection produces bold plotter output

The Gallery Collection

There is a theory about graphics programs which holds that if Lotus 1-2-3 did what it should do graphically, we wouldn't need anything else.

The graphing capabilities of 1-2-3 are not only difficult to use, but out of date at best and downright ugly at worst. So there is plenty of room for graphics packages that do everything from simply prettying up some of 1-2-3's worst uglies to supplying more kinds of presentation tools than Lotus will ever think of.

Beyond 1-2-3

The Hewlett-Packard Gallery Collection falls somewhere toward the far end of this range of products: it is a powerful presentation tool with a powerful price of $1376. Together, Charting Gallery and Drawing Gallery, its two separate applications, go way beyond the limited graphics of 1-2-3. The package offers a

number of graph types, good text annotation capabilities and a complete drawing program with extensive clip art libraries. Its capabilities for exporting graph and data files and supporting a wide variety of output devices add to its power and usefulness.

With this package, a beginner can produce a basic graph just by booting up the application for the graph type of his choice and following the menus. To use the more-advanced functions, such as editing data and enhancing a chart with the drawing program, requires some expeditions into the manuals. But then, you didn't really expect that any program this powerful was going to be easy, did you?

The work begins right out of the box with the installation process. Installing The Gallery Collection on a hard disk — including bar, line and pie chart applications, the Drawing Gallery and two clip art libraries — means handling 13 floppies.

The Gallery Collection will run on Hewlett-Packard's Vectra and Touchscreen PCs or on any IBM PC or compatible with 384k RAM and DOS 2.1 or later. HP reports that once The Gallery Collection has been patched to fix a problem with skipping the first screen, it can also run in the compatibility box of Hewlett-Packard's version of OS/2. The distribution disks include .PIF files for operation under Microsoft Windows. The Drawing Gallery requires a mouse or a graphics tablet. The minimum storage configuration is two floppy disk drives: one high-density (1.2Mbyte) and one 360k.

Dealing with the program's user interface is real work, too. The Gallery Collection is command-key driven: a row of labelled blocks across the bottom of the screen correspond to function-key choices. A prompt line at the top of the screen is the only online help the program offers. Across the middle of the screen, the graph in progress is displayed to scale (which leaves the left third of the screen empty). The graph is replotted every time the user returns to this 'main menu' screen from performing any function, whether it affected the graph or not. Waiting for this replot can become extremely tedious.

The menu structure is complex and the use of function keys is awkward — particularly when stepping through a list of options. The filing functions in Charting Gallery become especially aggravating. The program uses only the first eight function keys until it gets to filing, when F10 is assigned a function; and Drawing Gallery uses a different interface for its filing functions.

A welcome draw

Drawing Gallery is a welcome addition to the package. Its connections to Charting Gallery are only the very loosest: a graph must be saved in the drawing program's file format, and once saved, it can't be reopened in Charting Gallery. But once a graph has been brought into the object-oriented Drawing Gallery program, its possibilities become almost limitless. It can be sized, combined with other graphs and annotated with text or graphics. The Gallery Collection includes two clip art libraries, a basic collection of artwork, borders and fancy initials; and the Business Management Portfolio, an extensive collection of graphics, forms and symbols, as well as an especially good selection of world maps.

It is possible to use Drawing Gallery for simple tasks — such as placing a clip art icon on a graph — without a mouse, but using cursor keys to control a drawing program is almost as productive as sitting and watching paint dry.

The program supports HP's LaserJet laser printer at a resolution of 150 by 150 dots per inch, which means that the

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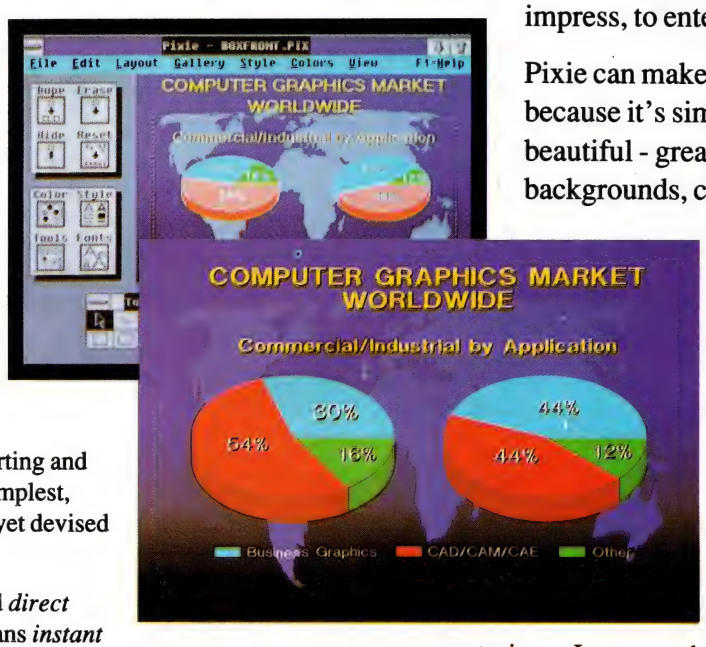
GIVES YOU THE PICTURE

Beautifully Simple

Simply Beautiful

Consider this: How many Pixie menu selections does it take to create a complete bar chart - with annotation, axes, title, and legend? Just *one*.

How many menu selections are needed to change the bar values? Add to the title? Change the axis scaling? Add more bars? Would you believe... *none*.



Dimension Graphics introduces Pixie, a new charting and drawing program with the simplest, most obvious user interface yet devised for presentation graphics.

In technical terms, it's called *direct manipulation*. To you, it means *instant learning* - and because it's so visual, Pixie is one program you'll never forget how to use.

Based on Microsoft® Windows, we think Pixie is the best example yet, in any software category, of the power of the graphical user interface.

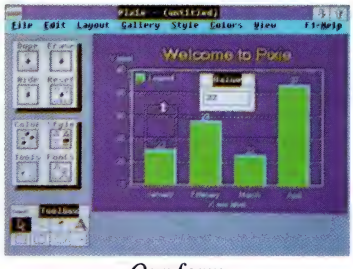
Deep down, you know why you invest in graphics: you want to look good. You want to impress, to entertain, to inform, to *sell*.

Pixie can make you look good. Just because it's simple doesn't mean it isn't beautiful - great colour, shaded backgrounds, clean typefaces, drop shadows, 3-D effects, and more.

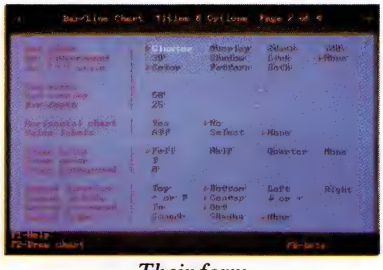
Take a look at the slide on the left. Does it look like it could be created by an amateur? In 10 minutes? With a less than $600 package? Thousands of Pixie users are making this very image: it's Lesson 3 (just six pages) in the Pixie manual!

Pixie is Zenographics' newest winner. It connects beautifully with their flagship product **Mirage** - the PC-based tool of choice for graphics professionals. Through Mirage, Pixie gains access to the best and most complete output device drivers, and to the artistic expertise of thousands of Mirage power-users worldwide.

	Pixie	Harvard Graphics	Freelance Plus
Graphical user interface?	Yes (MS Windows)	No	No
User interface technique	Direct manipulation	Fill-in forms	Fill-in forms
Editing preserved if chart changes?	Yes	No	No
Screen Fonts	Windows, Bitstream, Mirage	Helv, 1 hardware font	Stick
Maximum colors per image	16 million (Windows limit)	16	12
Compatible with professional systems?	Yes (Mirage)	No	No



Our form



Their form

Pixie

WINNER 1988

From

Zenographics

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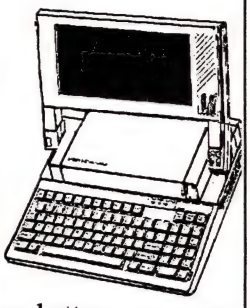
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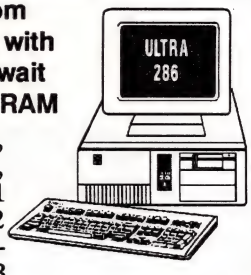
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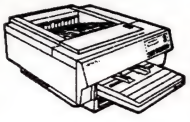
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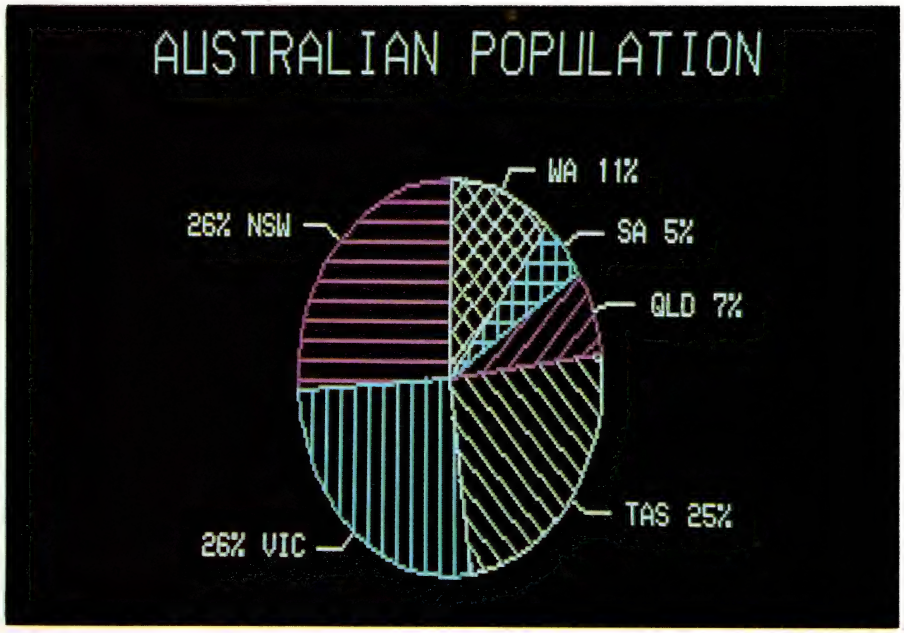
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Using GrafTalk, even the simplest pie chart involves an enourmous number of keystrokes

printer can produce a full-page chart without needing to be enhanced with extra memory. The Gallery Collection also makes good use of HP's PaintJet, the colour ink jet printer that may be the best thing to have happened to presentation graphics since the invention of the pie chart.

The quality of The Gallery Collection's output is good but not great. Its range of type fonts and sizes is severely limited, though it can be enhanced with Drawing Gallery fonts. Its selection of line and fill styles is adequate, though it doesn't supply the raster patterns that make best use of a laser printer. Its graphical style is utilitarian — no three-dimensional effects, no graduated fills. It is capable of making tasteful charts, but it can't save the user with no design sense from his own worst ideas.

Patience and artistic ability will be rewarded, however. With enough drawing capabilities to enhance the appearance of your files, Hewlett-Packard's Gallery Collection is a versatile and powerful — if not altogether easy — graphics program.

D DeJean

At a glance

The Gallery Collection, version 2.0
Supplier: Hewlett-Packard
Tel: (03) 895 2895
Price: $1376
Requires: 384k RAM, DOS 2.1 or later.
In Short: The Gallery Collection contains separate charting and drawing packages with extensive clip art portfolios. A good selection of chart types and enhancement features along with a complete drawing program make the package very powerful, but a clumsy user interface, a lack of online help, and the separation between chart and draw functions make it frustrating to learn and use.

GrafTalk

GrafTalk is a graphics package for producing business charts on a wide range of graphics output devices. The package runs on the IBM PC range of computers and can produce charts for four different kinds of graphics output devices: screens, plotters, printers and slide-making units. The package consists of four manuals, four disks and two 13 page booklets which summarise the installation of GrafTalk. It is capable of displaying a wealth of charts: bar, pie, line, symbol, text, step, high-low, bubble, regression, table and organisation charts.

Installation

On receiving the package, all disks were copied to the hard disk. Two files were executable programs: GRAFTALK.EXE and INSTALL.EXE. The GRAFTALK program could be run without any other installation steps needed. However, reference to the GrafTalk manuals was necessary to know the correct sequences for producing charts. GrafTalk addresses up to four different graphics devices at any one time. These are called screen, plotter, printer and other and each can have default values. For example, on the version I received, the default device for screen was the CGA graphics card and for plotter it was the HP 7475 pen plotter. The install program allows you to change these defaults. After viewing some charts in CGA graphics, I changed the screen driver to the EGA graphics card for more pleasing images.

Command languages

GrafTalk has a command language of 242 commands. All of them are clearly explained in the 'GrafTalk Encyclopedia' manual. Since remembering all of these commands and their sequence would be quite a feat, the authors of GrafTalk have provided five different modes for using GrafTalk. Each mode presents a different user interface to the program and is suited to different levels of user from novice to advanced. The modes in order from simplest to most advanced are called Prompt mode, Menu mode, Keyboard Command mode, Edit mode and Disk File mode.

In Prompt mode, the program asks the user question by question about the chart he wants. This mode makes a number of assumptions about what the user wants, yet even so, the user has to pass through the trial of answering a massive number of questions before a pleasing chart finally appears. All the questions have default answers so that a lot of the time you simply press return. At one point in the questioning, default settings were accepted — if they were not accepted then there would have been 24 questions before reaching the pie chart.

It was slightly disconcerting that many of the questions did not match with what the 'Primer' manual said would be asked. Another point of concern was that after answering question number 3 with a 'y', GrafTalk beeped and posted a warning message to say that it was going to 'reset all values to default settings except for the 'device' and 'no colour' settings' and asks would this be all right. It is all right, but it may well bewilder the first time user. Having drawn the chart, the proper exit from GrafTalk then involves another six questions and 10 keystrokes at minimum.

A number of questions are of the form 'Are you sure (Y/N)', which although su-

perfluous, may give more confidence to novices. The number of questions (apart from the superfluous ones) does indicate the amount of functionality built into GrafTalk's charting abilities. One aspect of the Prompt mode is that you can't go back to the previous question if you change your mind. This is not so with the Menu mode.

In Menu mode, a large 20-item menu fills the screen with room for accepting numeric choices in the top right hand corner. Item one of this menu is labelled help. When it is invoked, a long text message scrolls rapidly across the screen. No indication is given of how to stop the scrolling or even if this is possible. (None of the obvious keys such as ^S/^Q or Scroll Lock did the trick.) The function key F10 also provides the same help message with the same fault. In comparison to the Prompt mode, only 36 keystrokes are needed to produce the sample pie chart, and a further five to exit from GrafTalk. The Menu mode is easier to use than the Prompt mode, and corrections, changes and replots can be performed at any time in any sequence.

Keyboard Command mode is the default mode of GrafTalk. In this mode you have to know the 242 commands and key each command in as needed. It accepts upper case or lower case equally. This mode usually requires many keystrokes. However, to produce the sample plot only takes 40 keystrokes because the default values are accepted. All the GrafTalk commands are directly accessible in this mode. Edit mode is similar but allows the GrafTalk commands to be stored in RAM-resident files. The files can be run and re-edited. The use of files saves re-typing all of the commands when only small changes to a chart are wanted. Similarly, the Disk File mode allows GrafTalk command files and data files on disk to be run.

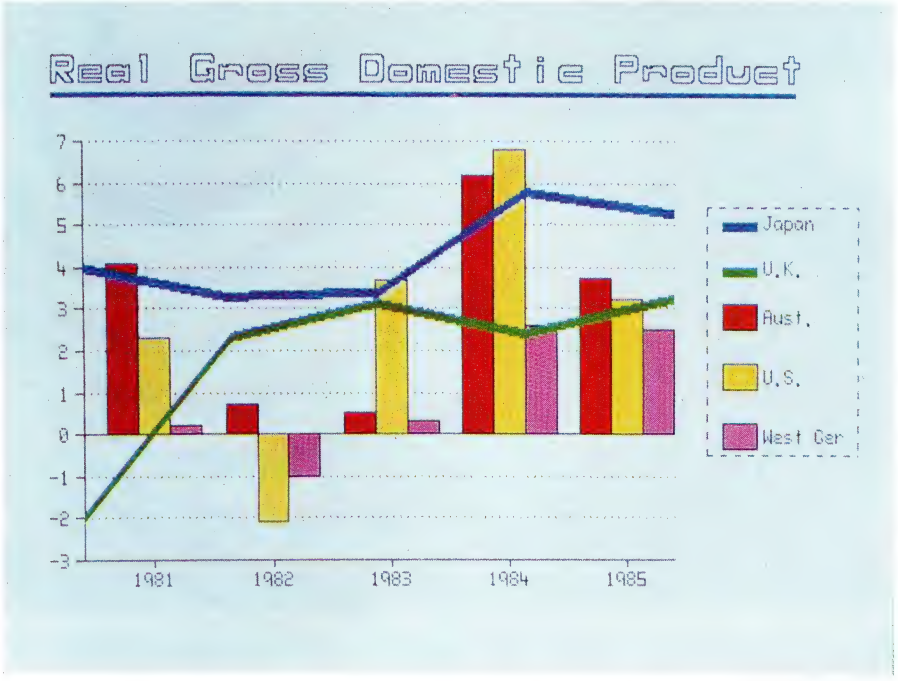
GrafTalk allows a choice from five available fonts in a variety of sizes, italics (sloped) or roman (not sloped), with three styles (stick, hollow or filled). Four different axes may be used on one chart — top, left, bottom and right hand sides. The graduations can be major/minor and may be logarithmic. Colour and shading is selectable for every entity in the chart. GrafTalk also has a rather primitive sketch mode for touching up charts. Only one device is selected at a time for graphics output. I found that selecting the plotter and plotting a chart often caused the DXY-980's error LED to flash. On other occasions GrafTalk tried to send the plotter pen off its right hand plotting limit resulting in a truncated plot. By use of the GrafTalk 'size' command, the whole chart can be scaled up or down so that it will fit any plot surface. This point illustrates one of GrafTalk's greatest strengths — its programmability. Once programmed for a particular kind of chart, the high level command language need never be referred to again.

In summary, GrafTalk embodies a lot of charting functionality with a multiplicity of access modes. The package is handsomely documented with four handy manuals, which must be read and understood in order to be able to use the full versatility of GrafTalk effectively. It can be programmed to produce sophisticated presentation graphics thereby automating flexible chart production.

J Rankin

At a glance

GrafTalk, version 4.1
Supplier: Fagan Microprocessor Systems
Tel: (03) 699 9899
Price: $542
Requires: IBM PC/XT/AT or compatible with graphics screen, plotter, printer or slide unit.
In short: A programmable graphics package with substantial functionality in producing a range of charts. It has user interfaces for novice to advanced users. A handy tool for the production of business charts.



The Advanced Magician combines a number of graphics capabilities in one package. It can import more complex graphics from Windows, PageMaker or Ventura

The Advanced Magician

For high quality output in two or three dimensions with a wide variety of font types, even on cheaper printers, it's hard to beat The Advanced Magician. The Advanced Magician is an updated version of Magician, an Australian graphics package that has been around for about two years. The package is sold all over Europe and has just been released in North America.

The Advanced Magician combines a number of graphics capabilities in one package. While it can produce excellent presentation graphics and has good drawing facilities, it also includes a macro graphics programming language, some text processing features, a font design system, an interface to desktop publishing packages, a slide show system and a sophisticated printer driver editor.

Ease of use for the first time user

Once The Advanced Magician is started, it presents the user with blank work space. Along the top is a menu with 16 options. Underneath that is a status line that normally displays the version number. When a menu item is invoked, if it has subsidiary choices, they are displayed on the status line. Although this limits the package to two menu levels only, it does ensure that novices are not



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left wandering around lost in a menu tree.

Choosing line sizes, brush shapes and drawing colours is easy with all the choices laid out along the left hand side of the screen with the 'quit' box at the very bottom. Down the right hand side all the line styles and fill textures are shown. Simply by pointing and clicking with the mouse you can select any combination you need. Another useful feature of having the full set of choices on screen is that you never have to wonder what your current selections are.

The 'Obey' macro language

One very powerful feature of the software is 'log'. The Advanced Magician has a macro language called Obey. With 'log' on, any graphics created with 'graf', 'arc', 'box', 'circ', 'fill', 'line' or the pencil in 'brsh' can be converted into Obey commands automatically. These Obey commands can then be edited to correct any mistakes and can be used to store graphics for latter use.

The text manipulation option is also useful. The Advanced Magician comes with 13 fonts as standard which are available in small, medium, large or huge sizes. Also included under the text option is a font editor that allows you to adjust existing fonts or to create new ones. The font editor can also be used to produce any special symbols that are needed. The Obey 'log' function can be used to store Obey commands for pieces of text. If you have a number of graphics to produce that have the same text, then by recording the text using 'log' the first time, you can insert the same text in any other graphic.

Includes 3-D graphs

All the business graphics features are grouped under 'graf'. The Advanced Magician supports eight different types of graphs — points, lines, area, bar, stacked bar, horizontal bar, pie and 100 per cent. All these types are selected through a simple point and click menu and you can make a bar graph three dimensional simply by choosing the 3-D option. The package also supports mixed graph types and lets you display up to four different graphs on screen at once.

You can customise the graphs colours, fill patterns and text. If you are more ambitious, you can use the Obey macro language to customise the graph even further.

The Advanced Magician will accept and graph any standard ASCII files of numbers but it does not accept any standard worksheet file formats. A limited spreadsheet facility allows users to modify numbers or to enter numbers directly, but DR Graphics Research decided when developing the package not to support the various different files formats from the many spreadsheet packages on the market. This means that to import a file from a spreadsheet you must first convert it to ASCII. This is inconvenient, and if you are using large spreadsheets it can become annoying.

The failure to support spreadsheet file formats is the package's weakness and it compares poorly with packages that have dynamic linking.

At the end of the menu is the 'view' facility. This lets a user set up complete presentations or 'slideshows' making it easy to prepare a simple show with simple menu choices to determine the order and speed of the screens. The system doesn't let you specify any fancy animation features such as 'wipe' or 'fade'.

However, one way to jazz up your presentations using The Advanced Magician is to use the 'Obey' macros. Animate the presentation by drawing the image on screen and then fill it in with colour. Indeed, by ordering the macro commands you can have the image drawn on the screen in any order you like.

Full drawing capabilities

The package has features for drawing lines, arcs, boxes and circles. It also has a freehand drawing facility called 'brsh' and a 'fill' feature for adding colour or patterns. 'Edit' can copy, move, invert or zoom in on any drawing element.

While it is not as fully featured in the drawing area as a full blown CAD package, it will provide most users with enough features to create graphics or modify graphs. The Advanced Magician

At a glance

The Advanced Magician
Supplier: Sourceware
Tel: (02) 427 7999
Price: $850
Requires: 640k RAM, DOS 2.0 or later, hard disk is recommended but will run from dual floppy, EGA or VGA.
In short: An easy to use powerful graphics package with more features than most graphics packages. Its lack of importing facilities can be annoying.

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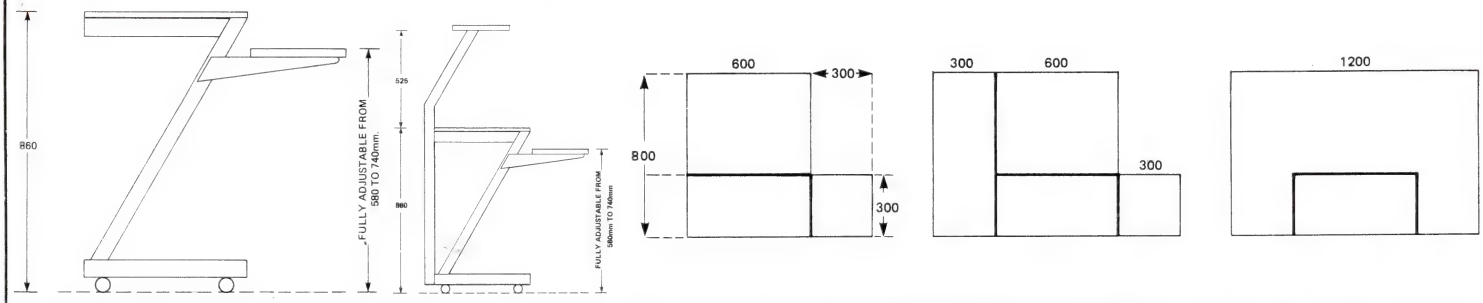
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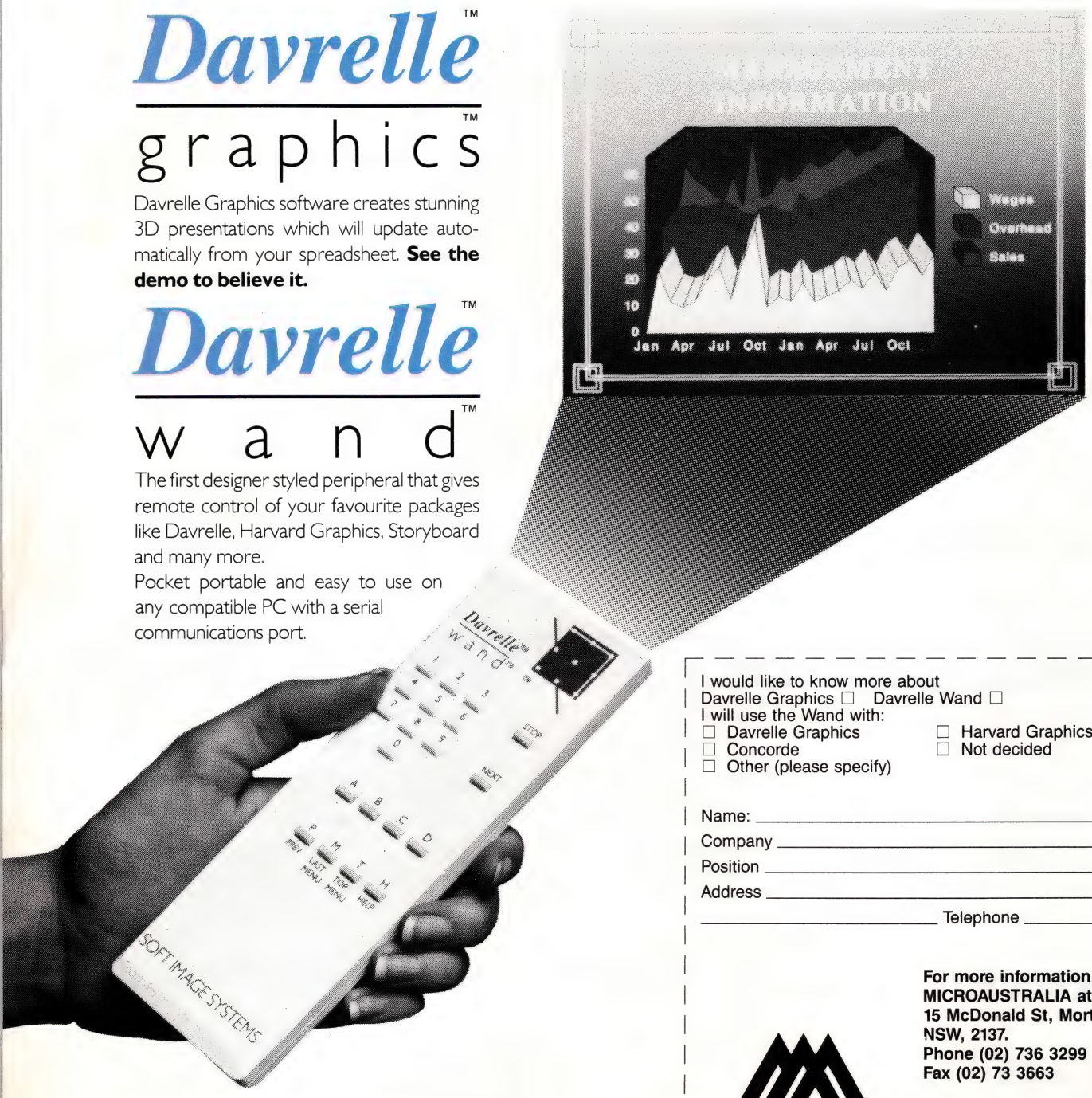
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can import more complex graphics from Windows, PageMaker or Ventura.

Both text and graphics can be be exported to Ventura, PageMaker or Microsoft Windows.

There is a handy 'undo' menu item that can take you back a step. If the 'log' function is activated, then by editing the Obey file users can step back as far as they need through the creation of a graphic. And finally, there is a comprehensive online help system under 'help' and under 'opts' you can set various defaults and options.

Mouse/keyboard operation

While it is possible to use The Advanced Magician without a mouse, it would certainly slow you down. Unlike some packages, you don't have to choose between using a mouse or the keyboard as both can be active simultaneously. The keyboard controls like 'page down' are useful for gross movements like scrolling through a long list of files. The mouse, once you have found the right general area, is useful for selecting files. An experienced user can zip around using a combination of mouse and keyboard.

Printing facilities

The latest version of The Advanced Magician includes a powerful printer driver editor. Although Magician provides drivers for most of the common printers, it also provides the driver editor. This allows you to create a driver for any printer or even to produce two drivers for the same printer for printing different items. The editor is simple to use and has extensive online help facilities.

Indeed, printing is one of the strong points of this package. It supports full colour printing as well as the normal black and white and grey scales. The drivers are more sophisticated than average, especially on usually ignored cheaper printers, and it also includes support for plotters (specifically the Hewlett-Packard Graphics Language) and lasers.

J Horey

GEM Graph Presentation Pack

Quite an assortment of Digital Research applications has found a home under the GEM roof, including a desktop publishing package, a word processor and a pixel-based paint program. The company has taken three of its integrated GEM applications — GEM Graph, GEM Draw Plus and GEM WordChart — and bundled them together to create a high-end business graphics product dubbed the GEM Graph Presentation Pack. This $840 package provides all that most users would need to render their numbers in the most visually effective graphic form, and it has the added advantage of compatibility with the other GEM products.

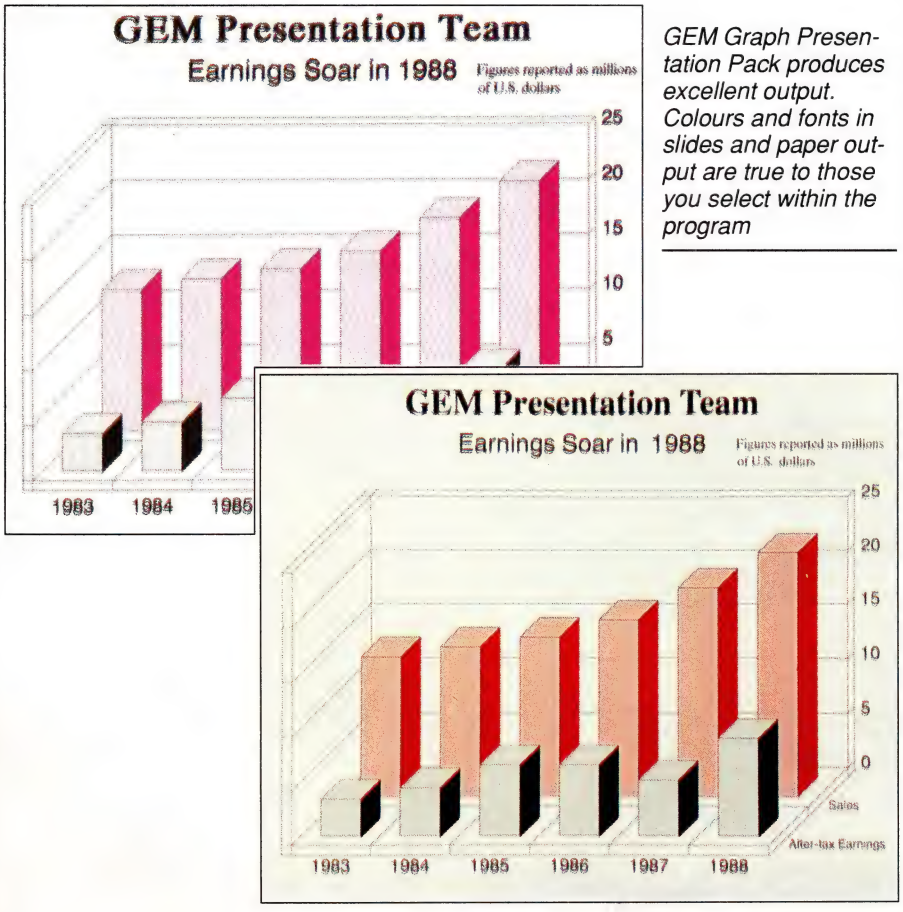
Each GEM application comes with GEM/3 Desktop, which provides a Microsoft Windows-like graphics-oriented operating environment and a common interface for the application's components. This type of environment is best suited to a mouse, although one is not strictly required. Finding your way around in GEM couldn't be easier, since the menus are for the most part self-explanatory. Uncovering some of the Presentation Pack's less-obvious features can be a challenge, since the documentation suffers from a meager index. But once you've learned the program, even the most complex operations become second nature.

GEM Graph lets you import data in a number of formats and then displays it in a screen that resembles a spreadsheet. All labels and headings are imported into data cells, so you have to move them to the correct locations yourself. Fortunately, this is an easy task, since you can define cells, rows and columns, and delete, move or edit them as you please. A handy Flip Data option lets you transpose all your data cells and labels so that what was on the x axis is moved to the y axis and vice versa.

A pull-down menu presents you with icons representing different types of graphs, and you just point and shoot to have your data graphed on-screen in the form you want. The choices include pie, line and area charts, as well as every conceivable type of bar chart. A symbol graph option turns out a chart in which bars are replaced by repeated pictographs representing such things as buildings, people or trucks. Replotting the data as a different type of graph is as easy as selecting a different icon.

The default layouts are exceptionally attractive and include automatically generated legends. You have the flexibility to make just about any adjustments required, and the display is fast enough to let you see the results of your changes almost immediately.

Most graph types default to perspective 3-D, but a 2-D option is available. You have a good deal of control over the



GEM Graph Presentation Pack produces excellent output. Colours and fonts in slides and paper output are true to those you select within the program

background grid, the axis scales and ranges, line thickness, data point symbols and whether labels appear in a legend or along the graph axes. The program will even calculate and display percentages or cumulative sums for y axis values.

The manipulative approach

Whenever possible, the program lets you manipulate your images and select options as if they were physical objects, which is the most intuitive approach to graphics production. To change the colour or fill pattern of a graph element, you define it by pointing to it with the cursor and selecting the desired colour or pattern from a pull-down palette. To change the font or size of text, you point to the text label, then select the font and size from a pull-down menu. You can add text comments anywhere simply by typing them in at the cursor position.

The Presentation Pack comes with seven sizes of Times Roman and Helvetica built in and includes a third font that you can install yourself. Additional Fontware fonts are available from Megavision, but the price is steep — $372 per font — and you can install no more than four at a time.

Many users will find the graphics-editing capabilities of GEM Graph alone quite adequate. But if you want to infuse some extra pizzazz into your creations, you can call a graph up in GEM Draw Plus for further doctoring. This general-purpose object-oriented graphics program lets you select and modify any element or group of elements in the graph. You can adjust height or width, delete copy, or use the cursor to drag something to a new position. You alter colours and fill patterns just as in GEM Graph, but GEM Draw Plus offers a larger, 16-colour palette and a larger selection of fill patterns (37). There is also a facility for creating simple geometric shapes, as well as a freehand-drawing mode.

GEM Draw Plus allows you to call up two different files in separate windows and move or copy elements from one to the other by dragging them with the cursor. By this means, you can copy images from the program's good-sized library of clip art into your own graphs. You can also scale down several separate graphs and copy them all onto a single page.

The Presentation Pack provides no way of merging two separate graphs into one or of depicting two separate y axes in a single graph. You can, however, create a graph that plots one data set with a line and the others with bars.

At a glance

GEM Graph Presentation Pack, version 1.1
Supplier: MicroAustralia
Tel: (02) 736 3299
Price: $840
Requires: 512k RAM, DOS 2.1 or later.
In Short: This package consists of Gem Graph, Gem Draw Plus, and Gem WordChart all rolled into one. The program is easy to install and use; you directly manipulate objects on screen so that you see the results of your changes as soon as you make them. There is no direct support for film recorders, but high-quality slides, prints and transparencies can be produced by outside companies.

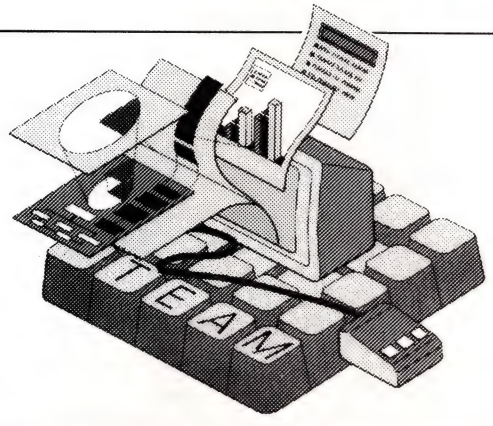
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MU 019 : PROFESSIONAL MASTERKEY - file, edit, search, un-delete.
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types of charts, GEM Draw Plus includes a library of templates and separate elements that you can copy and modify to create flow, organisational and Gantt charts. For developing text charts, there's the GEM WordChart module. WordChart lets you add various types of bullets to text, enclose it in boxes, add lines above or below it and create automatic outline numbering or lettering. The WordChart Template Gallery presents you with a screenful of icons representing the various templates you have at your disposal, including those you've created yourself.

In most cases, you can rest assured that the high quality of the graphics you create on-screen with the Presentation Pack will be matched in your hard-copy output. The package supports a wide variety of dot matrix, laser and ink jet printers, as well as plotters. Hewlett-Packard plotters, however, will not correctly reproduce the 3-D graphs created by GEM, so you must convert them to 2-D before plotting. The Presentation Pack offers no direct support for film recorders. The GEM Graph Presentation Pack is an impressive tool that lets you create eye-grabbing graphics with a minimum of effort. It gives you complete control over modifying any part of your graph, but its substantial array of capabilities never gets in the way of easy operation. Few products are such a pleasure to use.

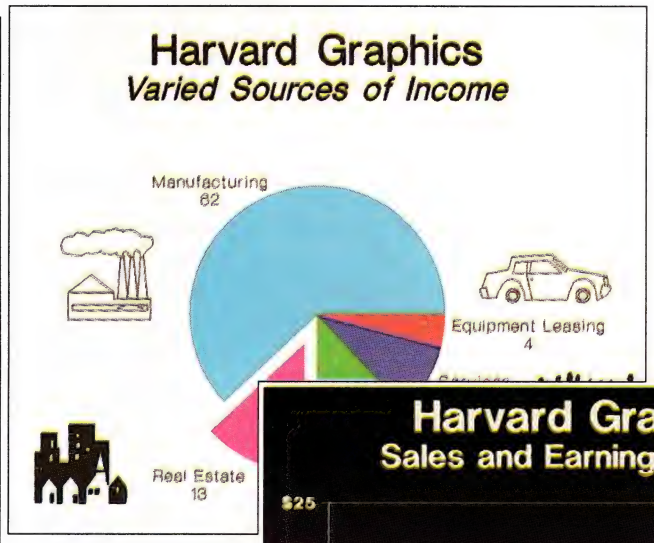
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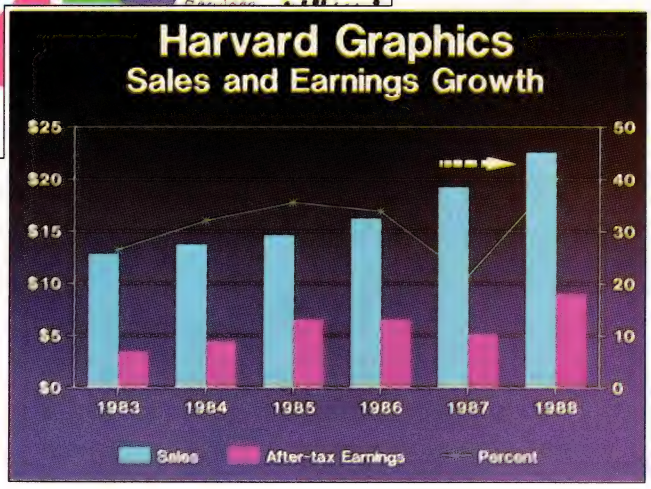
Harvard Graphics

If you think that producing presentation graphics is more trouble than it's worth, you've probably never tried Harvard Graphics. It is one of the most intelligently designed packages available; it makes creating charts and graphs an almost effortless enterprise.

Like most packages in this product category, Harvard Graphics lets you quickly graph and chart numerical data and text using default settings. Its approach is menu-driven and object-oriented: you make selections from a series of menus, work with fill-in-the-blank templates to create your charts, and then embellish them with shapes that you construct using graphics primitives.

Advanced tools like the package's macro program — which lets you record and play back a series of keystrokes — and batch printing serve experts and novices alike by automating and simplifying repetitive tasks. That's the balance between flexibility and ease of use that any presentation graphics program worth its price should strike.





Harvard Graphics' optional clip art libraries offer attractive image enhancement. However, the choice of symbols in the basic package, used here, is limited and sketch-like

Comprehensive offerings

Harvard Graphics offers a comprehensive array of chart and graph types, including text, pie, bar/line, area, scatter, high/low/close, organisation and multiple charts and their variants. Although the program does not provide ready-made formats for specialised charts like Gantt, Pert, bubble and flow charts, you can create these using graphics primitives. Chart design options allow you to combine up to six charts on a page, select from six type fonts, reposition and resize your charts and add boldface, italics and underline to individual characters, words and lines. Although you're limited to using one font per chart, you can use several in multiple-chart combinations.

Data entry and editing couldn't be easier. After you've decided which type of chart to create, you enter data in a columnar screen where you also specify titles, legends and footnotes. Depending on the chart type you choose, you will have to fill out an additional form or two in order to select such options as a 3-D effect, a link between two pie charts, colours or fill patterns, overlapped or stacked bars, grid lines, legend placement and axis increments.

You can explode slices from a pie chart or add a 3-D effect to it, but you can't do both in one chart. Harvard Graphics' data entry, editing and options screens maintain a standard and well-organised look. And you can depend on the program's consistent use of function keys for previewing a chart on-screen, calling up context-sensitive help, adjusting text sizes or selecting font attributes.

If you choose the bar/line, area or high/low/close chart format, Harvard Graphics can do double duty as an analysis tool; it lets you use 19 keywords to perform arithmetic and statistical calculations, as well as to create four types of regression curves. You can perform calculations on several series or on just one. Having access to this feature means that you won't have to switch back and forth between your spreadsheet program and presentation graphics program when you want to do certain kinds of 'what-if' analyses.

Harvard Graphics' data and graphic import/export facilities will save you from needlessly duplicating your efforts. The program can import data and graphs created by Lotus 1-2-3, Lotus Symphony and Software Publishing's PFS:Professional Plan and PFS:Graph. In addition, charts created with Harvard Graphics can be exported to Professional Write and Harvard Professional Publisher, as well as to programs that read .CGM files. (Before you can export or import metafiles, however, you need to install

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certain Virtual Device Interface drivers from the Harvard Graphics utilities disk.)

Harvard Graphics' image-export files can work with desktop publishing programs, such as PageMaker and Ventura Publisher version 1.1, that read encapsulated PostScript files or Hewlett-Packard Graphics Language, although the vendor notes that images created with Harvard Graphics may look different after they've been exported. The program can also read data directly from ASCII files that are less than 256 characters wide, or from delimited ASCII files.

Linking your data

Even with the clearest instructions, importing data and titles takes some practice. Still, the program's import/export facilities are easier and more convenient to use than those of many other packages.

Also, a big time-saver is the program's automatic data-link feature, which lets you join a Lotus 1-2-3 worksheet or ASCII file to a chart template. You'll find templates useful even when you don't need to import data, and you can create them for just about every chart of a style you frequently use. In addition, you can set up a template so that it includes annotations and graphics.

Just as Harvard Graphics' import/export options should prove adequate for most users, so should its support of peripherals. The package works with mice from several manufacturers, as well as the Kurta IS/ONE-Series Tablet. Whether your output medium of choice is 35mm slides, overhead transparencies or paper, you'll find the program compatible with an excellent range of devices: film recorders and video devices; dot matrix, ink jet, thermal and laser printers; and plotters. Printers and plotters can use 12 fill patterns; colour printers can use six colours plus black, and slides can use up to 16 colours.

You'll appreciate the option of using Harvard Graphics' ScreenShow facility and your monitor to create desktop presentations. ScreenShow lets you choose the order in which your slides will appear, how long they will remain on-screen, and how they will be removed from the screen. Transition choices include wipe, scroll, overlay, fade, weave, iris and rain effects, among others. You can also create a menu and paths for a screen show, allowing viewers to select the part of the show that they wish to see.

Minding P's and Q's

A 77,000-word spelling checker, based on the same SoftArt dictionary and engine used in Professional Write and PFS:First Choice, goes a long way toward separating Harvard Graphics from its competition — and separating you from your typing errors. Not only does the spelling checker identify words it cannot find in its master dictionary, words that are capitalised incorrectly, words and numbers that are punctuated improperly and words that are repeated in succession, but it lets you create a personal dictionary of often-used special words, much as a word processor's built-in spelling checker would.

As useful as it is, Harvard Graphics' spelling checker isn't without faults. It won't let you proofread as you type, nor will it let you check the spelling of particular words on the fly. If you realise that you've failed to correct a misspelled word after the spelling check has been completed and you try to recheck your file, you'll receive the message 'spelling check is complete' rather than an overlay box that identifies the error.

The art of it

Harvard Graphics' Draw/Annotate features are fairly robust and should meet most needs. However, you cannot zoom in on your chart in the Draw mode. You can add text or objects (such as circles, lines, polygons and ellipses) to your charts and stylise these additions with fill patterns and drop shadows. Grid lines and 'snap-to' lines make freehand drawing a more precise art. You can move, resize, copy, delete and group objects, but you can't rotate or mirror them or flip their axes as you can with some other packages.

Harvard Graphics' main weakness is its standard clip art library, which contains approximately 300 symbols. There are too many symbols that look as if they've been rendered by some graduate of a match-book-cover cartoon school, and still more that should be part of the package's standard repertoire but aren't. Clip-art fans don't have to settle for the symbols in Harvard Graphics' standard library.

An optional accessory product, Business Symbols ($159), provides more than 300 additional symbols, including those for computer and telecommunications equipment, three-dimensional objects, food packaging, office equipment, industrial buildings, traffic signs and more. Of special interest to scientists and engineers are the mathematical,

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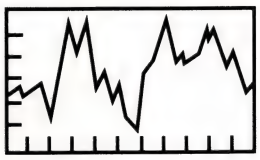
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At a glance

Harvard Graphics, version 2.1
Supplier: Imagineering
Tel: (02) 697 8666
List Price: $904; upgrade from Harvard Graphics, version 2.0, $144; upgrade from Harvard Presentation Graphics, $144.
Requires: 512k RAM, DOS 2.10 or later.
In Short: The de facto standard among presentation graphics packages, Harvard Graphics offers easy-to-use standard formats for creating and editing commonly used business charts.

Advanced features like macros, batch printing, and data links to Lotus 1-2-3 spreadsheets automate and simplify repetitive tasks complementing the package's user-friendly menu structure. A spelling checker, a ScreenShow feature, and connectivity to many popular programs add even more power.

chemical and element symbols, which dovetail nicely with the Greek alphabets. With only a few exceptions, its symbols are of higher quality and should prove to be more useful than those that come with the package.

Other options

In addition to Business Symbols, Software Publishing offers four other accessory products. ScreenShow Utilities ($239) is a set of three programs with which you can capture EGA text or graphic images and save them in .PCX format for inclusion in Harvard Graphics screen shows. Quick Charts ($239) is a collection of 125 frequently used business charts and matching templates. And Designer Galleries ($159) offers sample charts, matching templates with optimal enhancement choices, and colour palettes.

Of course, these accessories are just icing on an already rich cake. An impressive package even in the days when it was called Harvard Presentation Graphics, Software Publishing's program just keeps improving with age.

R Juris

Pixie

Pixie, Zenographics' entry into the business graphics market, emerged this year as the hottest outsider in the field. The ease with which you can get started in Pixie, its direct manipulation of graphics figures on-screen, its 'smart' responses to your graphics wishes, and its friendly, familiar Microsoft Windows interface make Pixie an interesting product for the business user who's not too serious about graphics.

For all you'll find in Pixie, there's a lot you won't find. However, in a product priced this aggressively, you may find the trade-offs are worthwhile. And if you want enhancements, they are as far away as Zenographics' $4058 computer-art product, Mirage. If your company already owns or plans to purchase Mirage, you can save your Pixie file in Mirage's .IMA format, pop it into the big sister's rich, creative environment, and embellish.

The growing importance of the Windows environment and Pixie's direct manipulation of on-screen graphics put the program at the front end of PC graphics technology. Through Windows/286, Pixie supports IBM's 8514 graphics monitor, simultaneously providing up to 256 pure colours from a palette of 16 million, in resolutions as high as 1024 by 768. Windows, however, does put limits on Pixie.

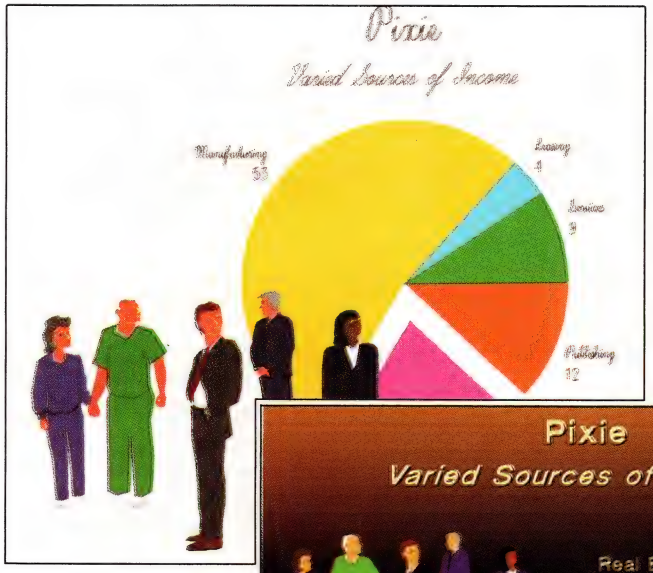
There's no driver for high-resolution film recorders, for instance, although you can export your files in SCDL Matrix camera format or in .CGM (Computer Graphics Metafile). Here too, Mirage gives Pixie a gateway to greater capabilities by giving you access to 23 graphics cards, nine film recorders, 25 printers and five plotters (if you export your files in the .IMA format). The fonts in Pixie, though fine for slides, are not supported by Windows printer drivers.

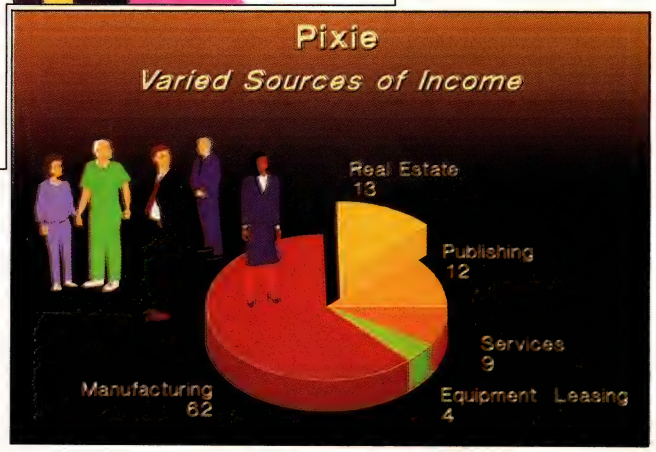
As a standalone package, Pixie can be confining. Pixie comes with only fine fonts, though you can customise the size, use italics or underline, and apply any of four densities of bold. If your graphing needs are text-heavy, you'll find a flexible word processor in Pixie, but without the spelling checker that you get in Harvard Graphics.

Regardless, for ease of use, a short learning curve, and the immediate gratification of watching your chart evolve before your eyes, Pixie is in a select league.

The direct approach

Javelin Software Corporation brought direct manipulation of graphics to the business world with its release of the Javelin spreadsheet. Business users could 'what if' data to their hearts content by manipulating the lines and bars in charts that they created in Javelin's graphics module. Paint packages brought the concept to the computer graphics world and Zenographics, with





Pixie produces stellar slides, but paper copy may disappoint you. Pixie's fonts are not supported by the PaintJet driver in Microsoft Windows; it printed script where we specified Helvetica

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Pixie, introduced it to presentation graphics software.

Direct manipulation is Pixie's greatest strength. Unfortunately, it's also the source of the program's biggest irritation. You must wait for your screen to redraw after every move you make. Because Pixie automatically changes your data as you stretch bars and massage pie slices, direct manipulation also raises the danger of inadvertently introducing errors. The careful executive will refrain from stretching graph elements to change data and, instead, will enter new numbers through the keyboard. Pixie gives you both options.

Pixie comes on two disks with an excellent 106-page manual. Installation is as easy as copying files from the disks to the Windows directory on your hard disk and then typing INSTALL. Pixie uncrunches its archived program files as it performs the installation, and within minutes you're ready to go.

Cute and friendly

Pixie's documentation sets a friendly standard that others should follow. The first three chapters (36 pages) of Pixie's manual are devoted to logical, well-paced lessons that make you Pixie's master in less than an hour. The rest of the manual is a concise, complete, well-indexed detailed summary of Pixie's features, options and abilities. End users in a busy office can learn the program in a short time and look up more-arcane details as needed.

To create your own chart, you simply edit what you see onscreen, using:

- the keyboard to clear Pixie's words and enter your own;
- the mouse to move, stretch, and pull the elements to where you want them; and
- the pull-down menus to access file information; edit the elements on-screen; change layout from landscape to portrait or slide; change chart types, colours, or style; and zoom in or out from various parts of your chart.

Pixie provides nine default charts, including word, bullet, table, bar, stacked bar, bar/line, line, area and pie. An ingenious user can create scatter and bubble charts by bringing up the line chart, clicking on all the data points on the line, and turning off the Edge feature in the style box. But the procedure is not documented in the manual. Your own intuition must take over where Pixie's cues leave off.

With each chart you create, you begin with one of Pixie's nine chart templates. You can add elements to these by clicking on an object on-screen, using a dashboard tool called Dupe to duplicate it, and then moving the clone to the position you want. The value of your data appears in dialogue boxes, and you watch it increase or decrease as you manipulate your chart elements.

At a glance

Pixie, version 1.02
Supplier: Dimension Graphics
Tel: (02) 929 5855
List Price: $596
Requires: 512k RAM, DOS 2.0 or later.
In Short: An easy-to-use program that performs well within its Microsoft Windows environment. Though limited in some areas, it sets new standards for graphics programs with its direct manipulation of chart elements and 'smart objects' that automatically adjust to your graphing needs.

Dashing into graphics

Using the dashboard tools, you can also tell Pixie to Erase elements in your chart (eliminating them altogether) or simply to Hide them from view. Hide is an especially handy feature if you're developing a build series. It is also useful when dealing with imported data. As with other programs reviewed in this issue, Pixie rarely displays imported data correctly unless you do a lot of editing in your spreadsheet. Even then, you will probably still have to use Pixie's tools to massage your chart until it looks the way you want it.

'The manual cautions you not to use clip art, 3-D effects or Zenographics' fonts . . . because these effects take an especially long time to redraw. Believe it.'

On import, Pixie typically assigns your data a legend, which you may not want to display on-screen. Since erasing the legend also erases your data, Hide becomes necessary. (In addition to Lotus 1-2-3 files, Pixie can also import ASCII, .CGM, VideoShow and Mirage files.)

Entering your data in Pixie is easy and even fun. You can change colours, fonts and type sizes on several lines at a time by 'marquee-ing' the elements (pressing the Shift key while clicking on the items you want), then indicating your choices on the dashboard.

With every choice you make — every change of data, colour, font or line style — Pixie redraws your chart. This lets you see the results of your selections immediately, but it quickly becomes annoying. A redraw occurs with virtually every click of the mouse, and if you're using anything slower than a '386 machine, the wait becomes time-consuming. The manual cautions you not to use clip art, 3-D effects or Zenographics' proprietary fonts until you've made your chart look just the way you want it, because these effects take an especially long time to redraw. Believe it.

Bang for the buck

If you need specialty features like slide-show capabilities and live links to spreadsheets, and if you want the ability to add rich enhancements to your charts without having to purchase Mirage, Pixie isn't for you.

It is a product to watch. Dollar for dollar, there is a lot of value and innovation here. As a graphics program that delivers simple but good-looking output with minimum fuss, it's as delightful as its name. You may love or hate direct manipulation, but even if you feel Pixie plays fast and loose with data, you can still enjoy the game. Pixie, quite simply, is fun.

C Ellison and P Seefeldt

35mm Express

As its name suggests, 35mm Express began its life as a graphics package designed to create images for slides. In the beginning, it did only that. In a continuing effort to make the program competitive with more-comprehensive packages, Business & Professional Software has released version 4.1, with a variety of new features and support for additional output devices. However, the package's lack of import options and its poor plotter output leave this $966 contender just short of grasping the brass ring.

35mm Express is a powerful program, but you'll find idiosyncrasies within it. 35mm supplies 32 fonts and supports over 40 output devices, and, perhaps because of that, the program includes 15 disks. The initial installation is straightforward, but it seems almost endless. During installation all fonts are loaded into the system, but they cannot be used until you go into the Defaults menu to install them for the device that

The Big Bang Theory.



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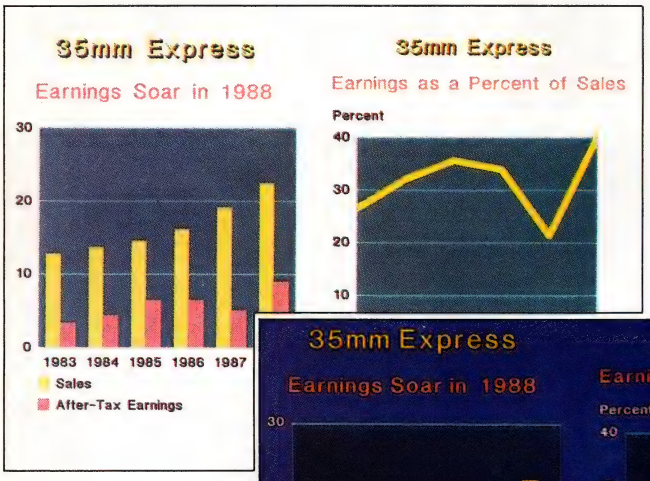
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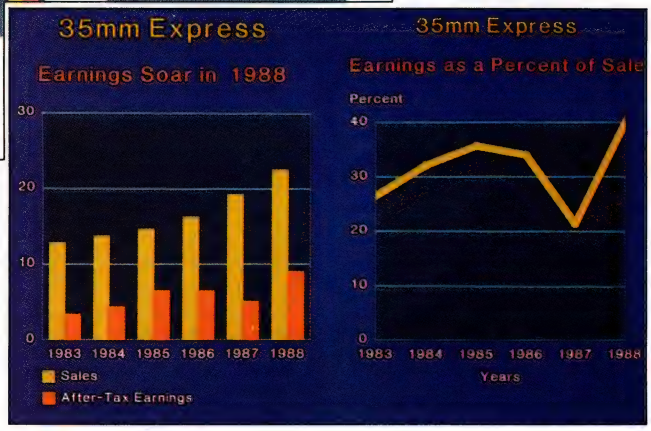
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WYS 3009/R





35mm Express was designed to produce slides but now supports a number of output devices, including the HP PaintJet, which produced the paper output shown with this slide

will use them. The process requires you to install and remove fonts and devices until your system is customised and all the options you need are at your fingertips.

Devotion to art

The icon-based interface is indicative of 35mm's extreme devotion to the art metaphor. The main menu presents you with fives symbols and titles: Create Edit, Output, File, Styles and Defaults. Select Create Edit and you're confronted with a picture of a set of file tabs, as you would see them if you opened your file cabinet to search for a folder. What is your subdirectory called? A cabinet. What are your files called? Folders. While icon menus may make beginners more comfortable with the program, redefining the concept of files and directories only creates confusion for users who are accustomed to DOS. For those seasoned users, the icons act as Lotus 1-2-3-style menus and can be selected by typing the first letter of an option rather than scrolling to it. Design menus are arranged as lists without accompanying icons and operate in the same first-letter fashion. If the above methods don't suit your personality, corresponding keystroke commands are also available.

'With a six-pen plotter, for instance, 35mm Express tries to create orange by loosely hatching red lines over yellow lines.'

Creating polished text and bar, column, pie, line, area, tabular or draw charts is a fast and simple process. Choose a chart type and the program customises its uncomplicated data form. Fill in the data, type /D for Display Graphic, and your graph will pop up in such a stunning default style that you may be wary of modifying it. Want to see how your data would look in a bar or line chart instead of a column chart? A few quick mouse clicks plug your data into all those chart types and more for your perusal.

35mm Express's extensive chart-editing options are among its greatest strengths. The program distinguishes between charts created in their original modes and charts converted to Draw mode. Any chart can be converted to a Draw chart, but not vice versa, so keep a copy of the original before making the conversion.

Convert charts to Draw to take advantage of 35mm's 100-symbol library, to create your own symbols, or to fine-tune your graph. You may find that the edits available outside of Draw mode are sufficient for most business graphs. Even without converting charts to Draw, you can add 3-D, change colours and fiddle with borders and sizes. The advantage of keeping a chart out of Draw mode is that it remains tied to your data; once a chart is converted to Draw, data changes no longer affect changes in the graph.

35mm Express is an ideal package for users who want to design a graph style unique to their company. You can modify the specifications of one of the program's 13 pre-designed styles, or create your prototypical graph in Draw, complete with company logo, and save it for future use.

If data import is high on your list of priorities, you may have to look elsewhere. 35mm Express imports Lotus 1-2-3 and Symphony worksheet graphs only. Note that 35mm doesn't import .PIC files; instead, the program works with that area of the worksheet you've defined as a graph through 1-2-3's graphing functions.

Lessons to teach

35mm Express has a few lessons to teach the top 10 packages about film recorder output — the quality is top-notch.

As for hard-copy output, only plotters disappoint. With a six-pen plotter, for instance, the program tries to create orange by loosely hatching red lines over yellow lines. Acceptable plotter output is certainly possible, but it necessitates printing out a colour palette, playing around with pen combinations, and modifying colours on-screen to match the plotter's capabilities.

The manual suffers slightly from program-expansion syndrome, mixing page numbers with letters and even words in an effort to accommodate recently added pages. Still, the manual is well written, and the Easy Start tutorials provide a concise introduction to the program's basic functions.

35mm Express doesn't have far to go to become competitive with the big sellers. Its $966 price tag pinches hard, but with slides so polished and design features so extensive, 35mm Express may well be worth your graphics dollar.

END

At a glance

35mm Express, version 4.1
Supplier: Minicomp Graphic
Tel: (02) 957 6800
List Price: $695
Requires: 256k RAM, DOS 2.0 or later.
In Short: Originally designed just to produce slides, 35mm Express offers a large symbol library, draw capabilities, and excellent support of film recorders; it can now produce paper copy as well.

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Power sharing



Increasing demand for disk storage, and the techniques for providing it, have been popular topics for some years now, but just why are larger disks needed? David Webber looks at the storage and performance of today's micro-based network file servers, and the integration techniques that provide them.

The capacity of Winchester disk devices for PC systems has been increasing at a phenomenal rate. At the same time, other improvements are making them smaller and easier to integrate. 20Mbyte drives are common-place in even the cheapest PC systems. The 'half height' drive is now a standard, with the older full height format being reserved for capacities of 150Mbytes and up. Intelligent interfaces are making the devices simpler to connect to microcomputer systems.

However, to some observers, these developments can seem like a solution looking for a problem. Traditionally (that is, the year before last) the hard disk was a way for microcomputer users to solve the problems of using their floppy disk drives. They achieved faster access times, their software was permanently loaded, and they could cope with databases which had swollen to a size bigger than half a megabyte. The 10 or 20Mbytes of the early IBM PC XT/AT systems was more than enough for these users.

But drive suppliers have been pushing at the boundaries of performance and whittling at the cost of these drives. The new drives, with capacities up to 380Mbytes, meet a user demand, but it is not coming from traditional micro users.

What is happening is a radical extension to the markets for micros, and the demands being made on them. Microcomputers based on the newer 32-bit chips, such as the Intel 80386, are being used for applications which would have required a minicomputer only a couple of years ago; and the low price of these systems means that they are available to a huge market, which dwarfs the number of users the minicomputer could ever reach.



STORAGE

Dealers and OEMs are responding to this market by putting together high-performance single-user systems and networks, using '286 and '386-based machines.

Today's 'power user' is the single user who hogs a '386 machine, develops programs, runs complex financial or other models on it, and holds huge databases. The other major use for the new, powerful micros is as the basis for multi-user networks which are, in all but cost, the counterpart of old departmental minicomputers. Interest in this kind of system is increasing since groups which would never have justified their own multi-user system before, have now become aware of the possibilities of the new, powerful micros.

But, as early users of supermicro systems discovered, there is more to departmental computing than a powerful processor. The processor must be part of a system. At the centre of this network is a file server which contains, on a hard disk, the information which would previously have been kept on paper; and this storage must have enough capacity, and give quick enough access.

Capacity

There is a rule of thumb for assessing the growth in a user's storage needs. If a user estimates that 100Mbytes of disk storage is required for the data currently kept online in a filing cabinet, 18 months later they will want 200-300Mbytes to keep records which would normally have been archived. New uses are thought of for the information; keeping last year's data on disk means that it can be processed in all sorts of ways. Trends which previously remained hidden in a pile of paper can be revealed to give the company a competitive edge.

Another factor boosting the demand for raw capacity is the increasing size of software packages. It has become common for a word-processing package to come on several floppy disks, all of which must be loaded onto the hard disk.

Desktop publishing packages often include many fonts — we are even beginning to see some which take so much space that they are offered on plug-in hard disk cards!

Many users, particularly those running extracts from large databases, notice that their work files, indexing operations and file reorganising utilities require up to 30 per cent of the disk to remain unused (otherwise there is no space to write temporary work files).

All this adds up to a big demand for disk capacity, which a developing tech-

nology is meeting. Thin film disks, in which the magnetic medium is a continuous layer of cobalt, are replacing the older, iron oxide disks in all but the smallest capacity drives. And new methods of encoding are multiplying the amount of data which can be stored on any drive.

Run-length limited (RLL) coding has been available for the last two years: it is a method which adds 50 per cent to the capacity of any disk drive by using special codes for repeated characters, thereby compacting the data on the disk. Although RLL is still new, there is already another coding method, Advanced Data Recording Technology (ADRT), which can virtually double the amount of data that can be stored on the drive.

To an extent, these higher capacities meet the needs of the power user and the network file server. As well as packing in more data, they allow it to be accessed more quickly. ADRT, for instance, takes the data transfer rate up to 10Mbits per second. In faster AT systems, this closely matches the speed at which the CPU can process data. It is also the same as the theoretical maximum data rate over a network like Ethernet, although in practice only around 2-3Mbits of useful data can be transferred over most Ethernet installations, due to the amount of protocol information and other constraints in networking systems.

Design

But raw capacity and fast access rates are just not enough. The whole system must be designed to do its job well, and that includes providing access to data without the kind of bottlenecks which can slow the system right down.

This kind of issue has been dealt with very thoroughly by minicomputer designers, and a number of solutions have been developed over the years, including cache memory and communications subsystems. These lessons are now being applied again in the microcomputer world, with some important differences.

The basic design of the system is different. Instead of a central unit which handles processing, data storage and program storage for a number of 'dumb' terminals, the network has a set of workstations which all have some local processing power; some will have local disks as well, but they all rely on a central file store for shared data.

Aided by recent developments in disk storage, VLSI circuitry and memory chips, and with the advantage of a clean slate to work on in many aspects of system design, the micro-based file servers

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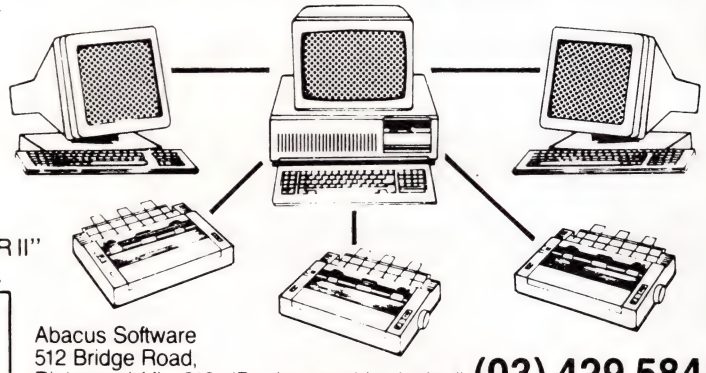
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ADRT disk drive controllers

When the ST506 Winchester disk drive interface was introduced in 1980, it was designed to keep within the tolerances to which disk drives and media could then be manufactured. The interface became a very widespread standard, approved as ANSI standard 412. Since then, however, many of the specifications of drives and media have been improved, with the result that greater performance is possible. Advanced Data Recording Technique (ADRT) modifies the ST506 interface to take advantage of these improvements.

In 1980, magnetic media had a coercivity of 300-350 oersted, motor speed stability tolerance was from one to four per cent, and the read-write head flew more than 12 microns above the disk surface. There was no electronic error detection and correction; the ST506 interface used a type of data recording technique based on Run Length Limited (RLL) encoding and called Modified Frequency Modulation (MFM, see Note 1). The data transfer rate through the heads was limited to 5Mbits per second.

Since then, the motor speed tolerance has dropped to one per cent or less, flying heights are 10-12 microns or lower, and the accuracy of the head positioners and the sensitivity of the internal signal processing circuitry have been improved. The quality of the media has increased dramatically; thin film media are widely available with a result that coercivity (see Note 2) has gone up to 600-700 oersted (see Note 3).

High-quality drives of this kind are readily available from Seagate, Maxtor, Miniscribe, Fujitsu, NEC and others. Yet the ST506 interface remained unchanged, so the performance improvements have not been exploited.

An improved run length limited coding (RLL 2,7) was devised as a way of keeping the same interface, but using the performance of the drive more fully (see Note 2), RLL (2,7) increases the data rate to 7.5Mbits per second so that data is written faster to the rotating disk, and allows more densely packed data. The RLL (2,7) specification increased the number of 512-byte sectors on each track of the disk, so that there were 26 sectors rather than 17; this resulted in one and a half times as much data on the disk.

Advanced Data Recording Technique (ADRT), which was first introduced late in 1986, goes a step further. The number of sectors is increased to 31 or 34 per track, and the data rate to nine or 10Mbits per second, while retaining the RLL data encoding technique. By taking advantage of higher coercivity to support operating at higher frequencies and thus data speeds, an actual reduction in the number of flux reversals created in the media is achieved compared to RLL (2,7). Flux reversals are no more than they are for the worst case with the standard MFM coding used in ST506, so the media and heads are able to operate within the magnetic flux tolerances for reliable data transfer. The time period used between data pulses remains at the 100 nanoseconds specified for the ST506 standard.

The 9Mbits per second version of ADRT produces a code

at the centre of these networks can be made many times cheaper than their minicomputer counterparts. However, with most '286 and '386-based systems using IBM's original PC/PC AT design, there are limitations which are necessary to sidestep.

DOS was never designed as a multi-user, multi-tasking system (unlike Unix and Xenix). It is also limited to the 1Mbyte address space of the 8088, of which 640k is available for the operating system and programs, while the rest forms a hardware system area. For those wanting to use DOS applications in such a multi-tasking, multi-user environment, several solutions are available, such as PC-MOS, Novell and Concurrent DOS.

There are several different approaches which can configure efficient network file servers based on micros. Different users need a varying combination of these approaches, trading off one characteristic against another to meet their price and performance needs.

In all cases, between the disk and the processor there is a controller which plugs into the microcomputer's expansion bus. The controller can be one of several different types, including the older ST506, and the newer ESDI and SCSI. Other items can be added to this chain of control.

What is certain is that very few users will buy a 'bare' disk drive and integrate it themselves. Most drives follow an involved path to the market, packaged by OEMs and distributors so that they meet particular user requirements.

Offloading tasks

In high-specification micro-based systems, such as 80386-based file servers, performance is being improved by designs which offload tasks from the central processor. Just as happened with the minicomputer, specialised jobs like I/O and disk control are being given to subsystems. The difference is that in today's micro-based systems, these subsystems consist of relatively cheap add-in boards, such as port I/O boards or disk cache controllers, which can improve overall system performance by a large factor.

The I/O board handles the communication between network stations and the central machine. This allows the central processor to concentrate on program execution without having time-consuming I/O interrupts.

A disk cache helps one or more users access the data on a disk, by holding frequently used data in solid state random access memory (RAM). When a request arrives for information on the disk, the system first checks the cache to see if it is already there; if so, it can retrieve it much more quickly than by moving the disk heads and reading it from the disk.

Caches can be made intelligent to various degrees, so they work more efficiently. Various algorithms are used to find the most-used code or data and keep it in the cache. For example, when one sector has been read in, the next request is very often for the following sector on the disk, so many caches automatically read in the next sector in advance so that it is ready when the request comes. (This is particularly useful when the disk usage has been optimised by one of the special programs which rearrange the data so that files are not 'fragmented', with sections spread out over the whole disk.)

Since the directory of the disk is accessed most frequently, the directory typically remains in the cache almost permanently.

In a micro, there are two basic options for cache configuration: hardware and software caching. Software caching simply sets aside an area in the processor's main memory for a disk cache. The DOS 640k memory barrier can cause problems here by limiting the space available for this technique.

It will almost certainly be necessary to extend the 640k limit of DOS. DOS version 3.3 and the normal buffers which handle the local disk and I/O devices take up around 100k. The network

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data rate which is always less than 6M flux change/sec, and the 10Mbits per second version produces a code data rate, in its worst case mode, of 6.6M flux change per second. The actual density of the flux changes on the media per inch of recording track which these rates produce, depends on whether 5.25in or 3.5in disks are used, and on whether the particular track is near the middle or the edge of the disk. With a typical 5.25in media drive, 9Mbits per second ADRT produces 6200 flux changes per inch in the outside track, and 10,362 on the inner track. 10Mbits per second ADRT produces densities of 6900 and 11,514 flux changes per inch for the inner and outer tracks of a 5.25in disk.

The faster flux reversal rate increases the possibility that the head may pick up an error from the disk surface; however, the addition of an error correction code means that most errors can be detected and corrected. Conventional MFM/RLL drive controllers use a 32-bit, 11-bit drop-out span, error correction code (ECC); ADRT controllers use 56-bit, 22-bit drop-out span, ECC, giving a probability of error mis-correction of less than one in 10^7, as opposed to one in 10^4 for MFM.

The original ST506 specification demanded a soft error rate of one error in 10^{10}, and the drives provide this when used at the original rate of 5M flux reversals per second. Increasing this rate by 20 per cent to 6M or 6.6M flux reversal per second for ADRT increases the error rate to between one in 10^8 or one in 10^2, depending on the disk drive used. Thus, the extended error correction code cuts error rates down to between one error in 10^8 to 10^{25} or better.

To supplement this, additional re-try algorithms are used to ensure that a stable and repeatable ECC is detected, and techniques to minimise head positioning hysteresis errors are used. Lastly, the controller contains circuitry to reject splinter-type pulses and other noise and signal jitter generated by the disk drive interface system. The net result is to produce an effective system error rate equal to or better than a drive without ADRT, and superior to RLL (2,7).

All this adds up to increased performance without any trade-off in reliability or error rate. It is made possible by the enhanced controller techniques and so improvements which had hitherto remained hidden in the newer, high-specification drives can be passed on to the user.

Note 1 MFM Process of varying the amplitude and frequency of the magnetic recording signal to obtain an increase in data storage capacity.

Note 2 Coercivity is a measure of the threshold magnetic field strength required to demagnetise the media. (It defines the magnetic force required to return the media to null effective magnetic flux after it has been magnetised to saturation). Thus, higher coercivity means less chance of data corruption, so more complex data patterns may be safely written to the media.

Note 3 Oersted The intensity of a magnetic field in a vacuum in which a unit magnetic pole (repels opposite pole at a distance of one centimetre with a force of one dyne) experiences mechanical force of one dyne in the direction of the field.

DYNE Force that accelerates one gram at one centimetre per second. One dyne = 0.00001 Newtons).

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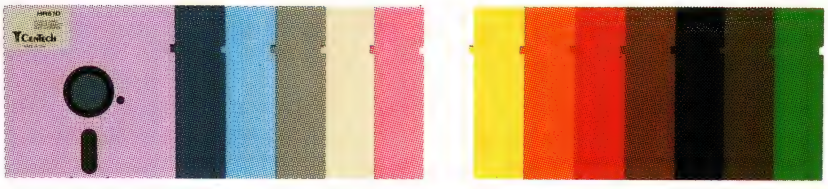
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Flux reversals

Controller Type	Sectors/ trk	ECC max	Data transfer rate	High frequency flux reversal rate, rising edge to rising edge (nanoseconds)
MFM	17	1 in 10^{12}	5Mbits/sec	400/200 peak
RLL	26	1 in 10^{12}	7.5Mbits/sec	600/200 peak
ADRT	34	1 in 10^{25}	10Mbits/sec	400/150 peak

software must be installed, along with buffers for each of the I/O ports onto the network. This kind of buffering can be done by the port I/O hardware. The port buffers in RAM typically hold screens, keyboard responses and so on, to prevent backlogs building up while the port outputs the information.

'Extended' memory takes main memory up to 1Mbyte, while expanded memory (EMS) uses bank switching to take it beyond that to 16Mbytes. Either of these gives room for a cache in the main memory, with a substantial performance improvement over an uncached disk drive.

A hardware cache, on the other hand, is connected between the drive controller and the data bus. A typical such card will provide 1Mbyte of cache for the disk drive. Since these cards are purpose-built as cache memory, and some of the logic is hard-wired, accessing a hardware cache is quicker than finding an area of the main memory which is acting as a software cache and then finding the required data within that.

Although expensive, the hardware cache may be justified since it releases the main memory for programs to be run locally on the system at the same time as it is acting as a file server, thus providing the system with a workstation for one more user, as well as boosting the performance of the others.

Hard cards

Among the more exciting recent developments are improved 'hard cards' — a disk drive physically mounted on an add-in board. These now offer an 'off-the-shelf' adaption kit for an AT-type machine.

These hard cards are co-resident, which means that they can be one of two controller cards in the system. Before any of the modern drives can be used in a PC/AT-type system, a limitation of the AT design has to be overcome by which IBM originally specified only 14 drive types and hard-wired its specification into the ROM BIOS.

Co-resident cards contain ROM whose address space overlaps the boot space. When the system is turned on, it registers the presence of the hard card and loads the ROM program. This allows two disk drive controllers to be used at once.

The newer 3.5 in drives are no bigger than a pat of butter and fit easily on these boards. Until recently, hard cards have played only a minor role in servicing the mass storage requirements of LANs because of their limited capacity and access time.

Now it is possible to have a hard card with 100Mbytes of storage, along with a SCSI interface and drivers which allow it to work with standard network operating systems. Such a card, added to a micro based on a '286 or '386 chip, can make the basis for an effective network file server.

Often, the high-capacity hard card is fitted in addition to an existing hard disk, perhaps a 20Mbyte drive. This allows the old drive to be used as a local disk separate from the network system. The old drive can also be used to provide a limited form of back-up: critical files backed up from the new hard disk would be safe from any fault such as software corruption.

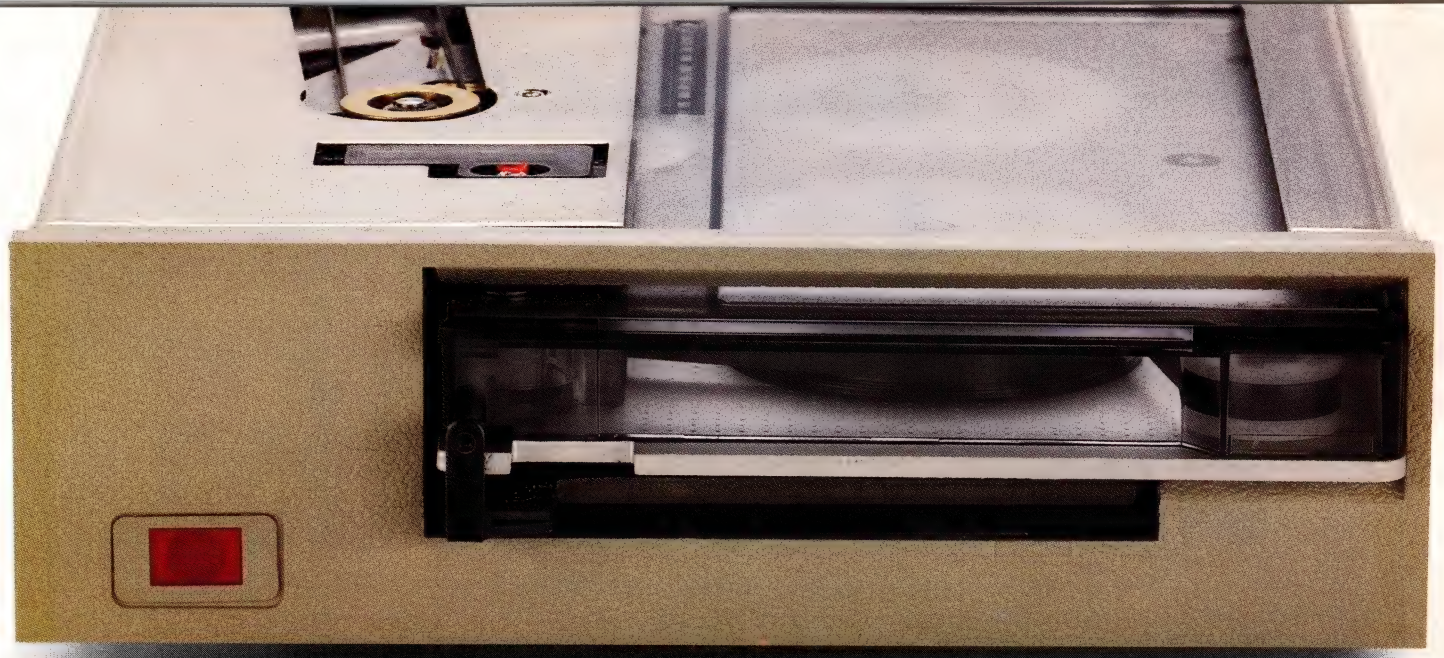
However, since a physical shock which damaged one drive would be likely to damage the other, the files should be backed up periodically onto a more permanent medium.

The future

The Winchester disk still shows plenty of scope for development and meets such obvious user needs that it will clearly continue to dominate the mass storage market. Optical disk drives will have only specialised applications until their ease of use and access speed improve.

The PC architecture, likewise, has an assured future, at least in the medium term. The installed base, the available software, and the hardware prices of the MS-DOS based PC and AT systems will keep them viable for a long time to come.

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Voice recognition

If computers are considered such an integral part of some people's lives, then, like Dr Doolittle and the animals, why can't we talk to them? Rupert Goodwins converses with two voice recognition systems from TVC and Cherry.

Computers in the movies have one big advantage over computers in real life — they understand the spoken word. Even the ones with refrigerator-sized banks of whirring tape recorders converse in natural English. It's sad then, that our micros stay obstinately deaf; while they can do more calculations in an hour than Einstein did in his lifetime and know how to spell Chrysanthemum, they remain as unmoved by vocal commands as a three-year old.

This is a perennial disappointment to many. If computers are so smart, why do they pretend to be typewriters? The trouble is that speech recognition is one of the many things that humans are splendidly designed to do; we find it so easy that we never think about it. But the amount of processing our brains do to turn a set of sounds into a train of mental images is immense, and the way we do it is poorly understood. Two seconds of speech hold over 100,000 bits of data — that's the same size as this article — and we can continually decode this information from a Glaswegian with a cold or an Australian with a megaphone.

To distinguish words from each other, some identifying features have to be extracted from the complex electrical signal that the microphone produces. Most of the information in a word is concentrated in certain frequency bands, which is why the telephone system is adequate for speech despite being severely limited audio-wise and hopeless for music. So a speech recognition board first extracts just the frequencies of interest — this is called filtering.

Then an analysis of the way that the signal changes has to be made. The word 'snake' starts off with a lot of high-frequency noise, then has some low-frequency nasal tones and ends up with a high-frequency explosion. 'Nibble', on the other hand, is all low-frequency but with bursts of power in the middle.

We're lucky, as we have ears full of fine bristles that wave at different rates to extract this information; the computer has to turn all the sounds into numbers representing changes in sound pressure and then do some mind-curdling maths to tell the difference. This is called digital signal processing, or DSP. The military spends vast amounts on DSP because it is both very useful and very difficult; this applies almost as much to speech recognition as to combat radar.

Physical descriptions

But the idea of true hands-off computing remains attractive, as do the very large sums of money to be made by the first cheap, reliable and unfussy speech recognition system. The potential applications are obvious and almost unlimited, and so the biggest names in the business have been throwing PhDs at the problem for decades. While there's no sign of the QWERTYless PC, a number of companies have produced add-ons for IBM-standard computers. Two of these are The Voice Connection (TVC), and Cherry; the latter a noted manufacturer of keyboards and thus very much hedging its bets.

The Introvoice VI from TVC is a half-length XT expansion card. It has sockets for a microphone and a loudspeaker, and a volume control. It's quite complex electronically; there are circuits to clean up and amplify the voice signal, analogue to digital converters to get it into computer-readable form, a speech synthesiser, and a ROM containing software. Some more software is supplied on a single disk, and a speaker and microphone of reasonable quality are provided.

'The biggest problem with this approach was the sheer speed advantage of typing.'

The VoiceScribe card from Cherry is full-length, despite having the same chip count, and is much emptier as a result. The circuitry appears to be similar in part, as it uses the same chips in the filter and amplifier section as the TVC card. The digital part is very different; it employs a Rockwell DSP chip with its own memory. Rockwell also sells a lot of DSP to various military outfits and is thus quite good at it, so it seems reasonable to assume that this board does a lot more work than the Introvoice. It does have the audio equivalent of typeahead, storing up to five distinct utterances.

Installation

Installing the Introvoice is simple. Plug the card in (there are switches, but these come sensibly set up), copy the disk onto either another floppy or a subdirectory on a hard disk, plug in the microphone and loudspeaker, and that's it. Information about what to do if you suspect that the board is in conflict with other hardware in your computer is towards the back of the manual, well away from the installation section. Some familiarity with PC hardware is assumed; if you're not happy with statements like 'When IRQ-0 is used, the 18.2MHz clock speed in the PC is modified to increase by a factor of five' and things start to go wrong, then you might need expert help.

Plugging in the Cherry board is almost as easy. Although it has a lot more options to set by links and switches, they are well documented. Unlike the Introvoice, it has some diagnostic software which attempts to check that all is well and prints up a terse error number should something be wrong. In my case, there was a link missing from the board which was swiftly remedied. There is no provision for a speaker as the Cherry board has no speech synthesiser, but as well as a microphone input there is a socket for a telephone handset. It comes with a very natty headset and boom mike, which makes sense: if you can hold a microphone you can probably type . . .

Installing the software for the Cherry board is not complicated, but it is lengthy. There are three disks; one contains the speech recognition software itself and some control programs; one contains an interface program to let the board work with common applications; and the last one has a copious programmer's library for those wanting to roll their own software. All these are described — at length — in the 400-odd page manual. Installation is just a matter of typing INSTALL, but the software goes on to modify AUTOEXEC.BAT and CONFIG.SYS files without making any sort of backup. No brownie points there.

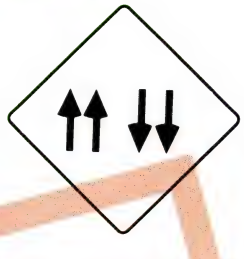
Software setup for the Introvoice is simpler. When the disk has been copied, a couple of commands install the memory-resident part (this takes up about 70k of RAM) and start the main utility program. This teaches the hardware to recognise your voice, and trains it to understand a vocabulary with a maximum size of around 500 words. The first thing to do, however, is run the demonstration program. This has a vocabulary of 12 words, and is a gentle introduction to the concepts behind voice recognition.

Getting recognised

Firstly, the system must be trained to recognise your voice. Neither of the systems reviewed claim to be a general-purpose, speaker-independent recognition system; they need to be told exactly what they are going to hear and who is going to say it. You are prompted to say each word at least three times — more if the system isn't sure that it will be able to recognise the word again without another chance to hear your version.



There are three roads to multi-user computing. Only one can guarantee a smooth trip.



Businesses, big and small, have come to rely on Personal Computers. Few can get by with just one. As you exploit the potential of your PCs, the demand for more computing power, storage and terminals will grow too. But bigger systems can also lead to problems if you choose the wrong growth path:

Does your system stall in heavy traffic?

How are file backups handled?

Will single user software work reliably with more than one user?

Is further expansion expensive?



There are at least three ways to build a mult-user PC system — Unix/Xenix, a Local Area Network, a clustered CPU system.



Unix/Xenix Systems

Unix is a great operating system but not for business applications.

Most software is written for DOS so a lot of programs just aren't available in Unix.

Unix is sophisticated, so staff need extra training to use the system effectively.

With one CPU doing all of the work, you will find yourself in the slow lane when the workload builds. And even with a fast processor, you'll notice the drop in speed as more users are added.

Local Area Networking

A LAN is a good way to link **existing** PCs together to share resources. But LANS are expensive. Each user needs their own PC, network interface and cabling, as well as the file server.

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And system management can become a nightmare as users keep copies of files on their own systems that are never backed up.



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At this point the delights and frustrations of speech recognition start to make themselves felt. The thrill of controlling a computer by talking to it is exciting indeed; the anger when it refuses to obey is similarly real. Even with the 12-word vocabulary, some common factors are apparent — short words like 'up' are liable to be ignored or misheard, whereas long phrases like 'toggle speech' have a very high success rate.

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This is a powerful technique as it will work with all application software that uses the keyboard. It's enhanced by dynamic vocabulary switching; after the software has recognised the word 'Directory' it will only accept those words that it knows are legal after DIR, and provide translations accordingly. For example, say that you want to display a list of files right across the screen. The DOS command for this is DIR/W, so you would teach the computer to translate 'Wide' to /W.

By putting this translation in a subvocabulary, and telling the computer only to use this after receiving the command 'Directory', you can be sure of never getting /W in the wrong place.

It gets better. Providing you use a separate subdirectory, you can teach the computer to translate 'Wide' as CO80, and by linking this to a translation of 'Screen' to Mode turn 'Screen wide' into

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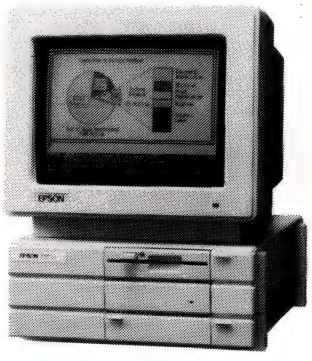


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The PCe also includes MS-DOS and GW-BASIC. But perhaps the nicest extra is its price tag of

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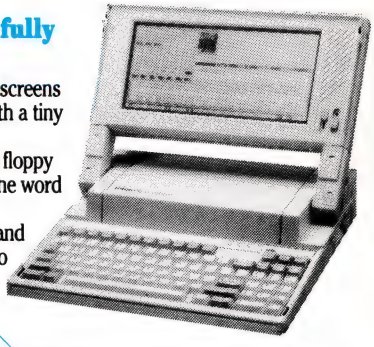
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Mode CO80 — the DOS command to use an 80-column screen mode. This might seem trivial, but the process of putting words in context is one of the most useful ways humans have of making sense of speech. How else to tell the difference between righting wrongs and writing home?

Another use for the subvocabulary system is to have a main vocab word 'Stop listening' linked to a one-word subvocab containing 'Attention'. If you want to talk to another human, telling the computer to 'Stop listening' will prevent spurious commands being recognised until you say 'Attention'. And having subvocabs limits the number of words that the recognition system has to scan at any one time: this increases accuracy by decreasing the number of possible mismatches, and it also speeds things up.

Introvoice in use

Manipulating vocabularies with the Introvoice is undertaken by the utility program. It has a simple editor which lets you type in a word, the keys (up to 1000 per word) that will be squirted into the computer when that word is recognised, and any associated subvocabularies. A subvocab is created by giving its name in brackets, and ended by (end). It took me about an hour to produce, train and use a vocabulary that let me talk to my communications software and send a file via Keylink without touching the keyboard.

The pre-canned vocabularies include one that can imitate any keypress, and thus can drive (slowly) any application program. Letters are recognised by the international phonetic alpha-bravo-charlie code, and Ctrl-Function and Upper Case have the expected effect. It took me about half an hour to write three sentences in WordPerfect this way, after which the software stopped recognising my voice. This was an intermittent problem throughout the tests.

The voice synthesiser was clear and American — useful for confirming recognition without having to look at the screen.

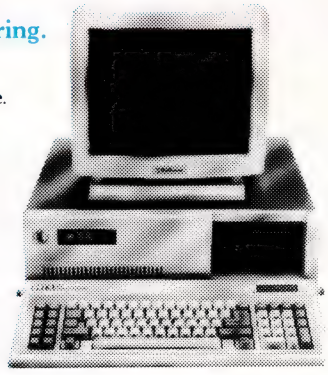
Support for programmers is limited to a couple of machine code programs designed to be linked with Basic compilers and providing software access to the speech synthesiser on the card. There is no information provided to allow the user to access the recognition functions through anything other than the supplied software. Other programs include an audio spectrum analyser which shows what frequencies are present in sounds, text-to-speech software which

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has a good go at fitting English pronunciation rules to any ASCII words, and a special vocab to drive SideKick in conjunction with Superkey. (More on this later).

VoiceScribe in use

The VoiceScribe software was written by Dragon Systems, and is a far more involved package. It's a complete development environment for application programmers; it has a long tutorial (called *Hands-on Introduction to Speech Recognition*, somewhat defeating the object of the exercise) and a language of its own called VOCL. This is really a metalanguage, as the application designer builds up a definition of a language which is acceptable to VOCL, and VOCL turns it into a form which the recognition system can act on.

This aspect of the VoiceScribe system is not suited for the casual user or the merely curious. Although it uses the same concepts as the Introvoice system — words once recognised lead onto specific subvocabularies — it is far more formal and includes concepts of precedence and the design of the language as a finite state machine. Finite state machines are closed systems with a limited and predictable set of internal conditions — fine for the professional engineer designing a specific application or the third-year cognitive psychology student.

More immediately useful is DragonKEY. This is a pop-up program that behaves in a similar manner to the Introvoice software. It trains the computer to recognise a word by getting the user to repeat it, and it lets the user associate any set of keystrokes with a recognised word. It's been cleverly designed: the first words it learns to recognise are those needed to use the rest of DragonKEY so the user can be in total voice control of the system within about half an hour. The information about words is held in files called overlays; unlike the Introvoice system these can be held in expanded memory. DragonKEY can switch overlays on a voice command, and it can share words between overlays to reduce the required memory.

Each word that DragonKEY recognises takes about 250 bytes, and it needs about 20k of space on top of this for workspace. The DragonKEY program itself uses about 120k, so for a useful system, budget about 180k. The program appears by the word 'Menu', and careful design again comes to the fore as reinforcement training (if a word fails often, you can retrain it) is easy without any need to touch the keyboard.

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Applications

What use is a voice recognition system to an able-bodied, reasonably keyboard proficient computer user? Firstly, it lets you use your computer over a distance by either a radio link or a telephone.

I tried to persuade the computer to listen to my telephone answering machine, and on recognition of a codeword start some communications software so that the next call would be routed to the modem. This seemed a good way to get access to my computer while I was away from home without using a second phone line or subjecting innocent callers to a screeching modem tone. This worked with limited success, due in part to the variable condition of the phone lines. Perhaps one call in three was recognised. With more training — patient repetition of a word does increase the chances of a successful match — it might be feasible. With the Introvoice, the possibility exists for the computer to log onto an electronic mail service, receive any messages and then speak them over the phone, all on receipt of a password phoned in from anywhere.

Another application tried was the voice-activated pop-up. Both the boards proved capable of 'waking up' memory-resident programs, and then feeding them commands or data. The biggest problem with this approach was the sheer speed advantage of typing: even with hands full, it was quicker to put down whatever was being carried, press the keys and pick the stuff up again than to spell out the request using phonetic language. The bigger the vocabulary, the worse the response time and the more mis-matches are made.

Conclusion

Voice recognition is still in its infancy. In limited, predictable situations the boards tested did well, although I couldn't achieve the 98 per cent claimed for the Introvoice. I averaged 70 to 80 per cent for the Introvoice, although it did tend to give up completely after a while, and 60 to 70 per cent for the VoiceScribe which didn't crash or get confused at any time. With more training, the VoiceScribe could provide better results; it was still improving with each training session. The audio buffering was annoying at times; as the board could take up to a second to mishear a word, I could be three words on by the time the mistake came to light. Muttering swear words at the machine only confuses it more!

If the voice input is going to be the only major way of controlling your computer, if you're disabled or otherwise unable to use a keyboard, then the Cherry VoiceScribe together with a friendly, competent programmer and a few weeks to build a solid system seems the best solution. Likewise, the Cherry is better for professional designers, because of the much higher level of technical information and documentation.

For the experimenter, explorer or evaluator, The Voice Connection's Introvoice is a better idea, as the speech synthesis and far simpler environment produce more immediate and useful results.

But there's a long way to go to 2001 and those pod bay doors. Make the most of it — one day your telephone exchange will be all ears.

END

Introvoice VI costs around $1200 and is available through WorldWide Business Systems, tel: (03) 890 1530. VoiceScribe is available through Swann Electronics, tel: (03) 560 7555. Pricing is currently not available.

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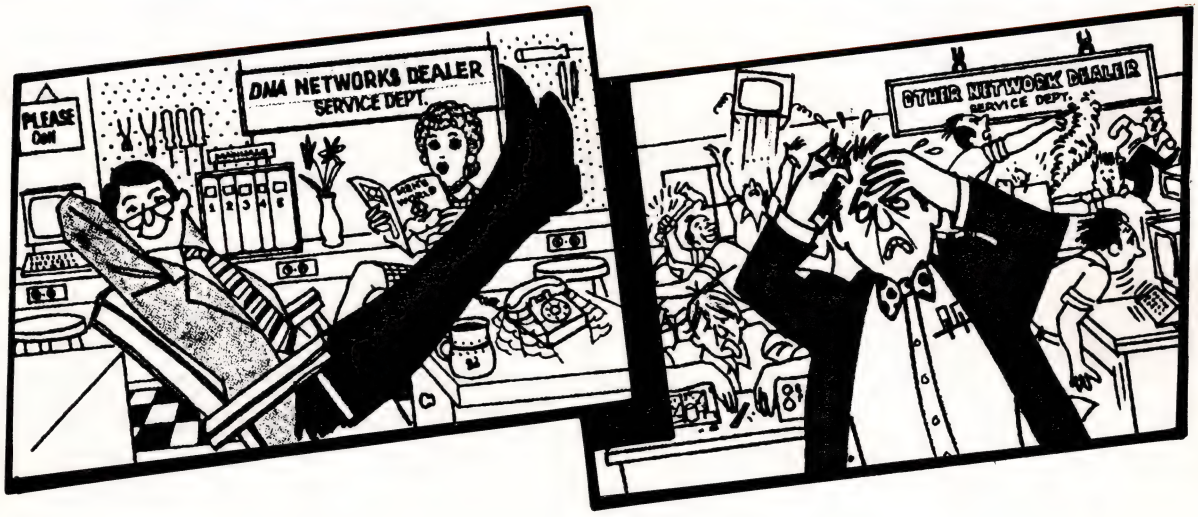
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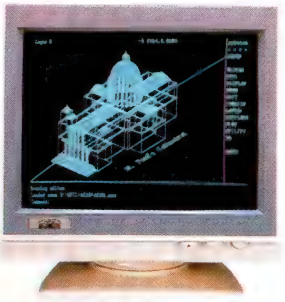
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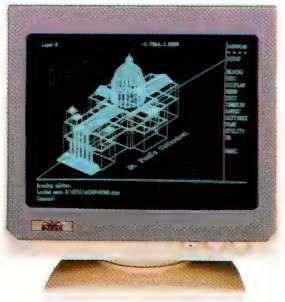
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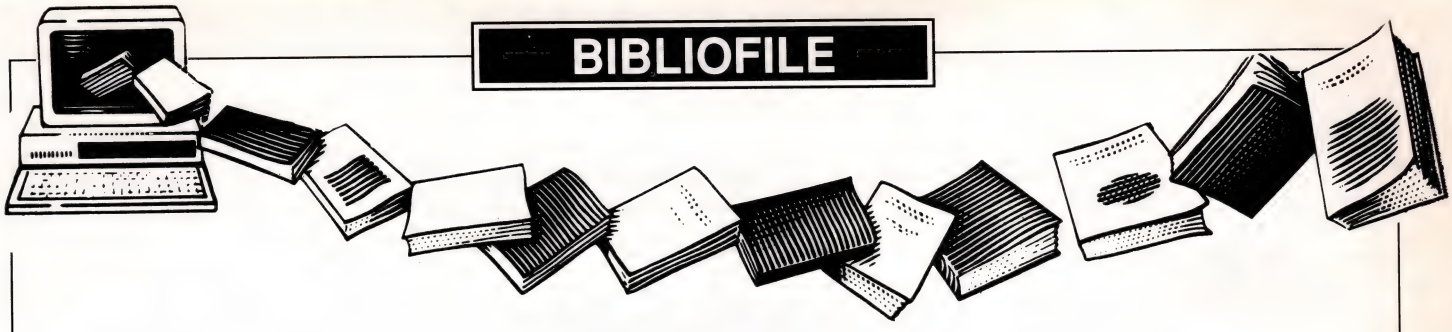
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There's more to parallel processing than meets the eye. Our panel of reviewers helps you sort out the good buys from the bad.

Parallel Processing: the transputer and occam

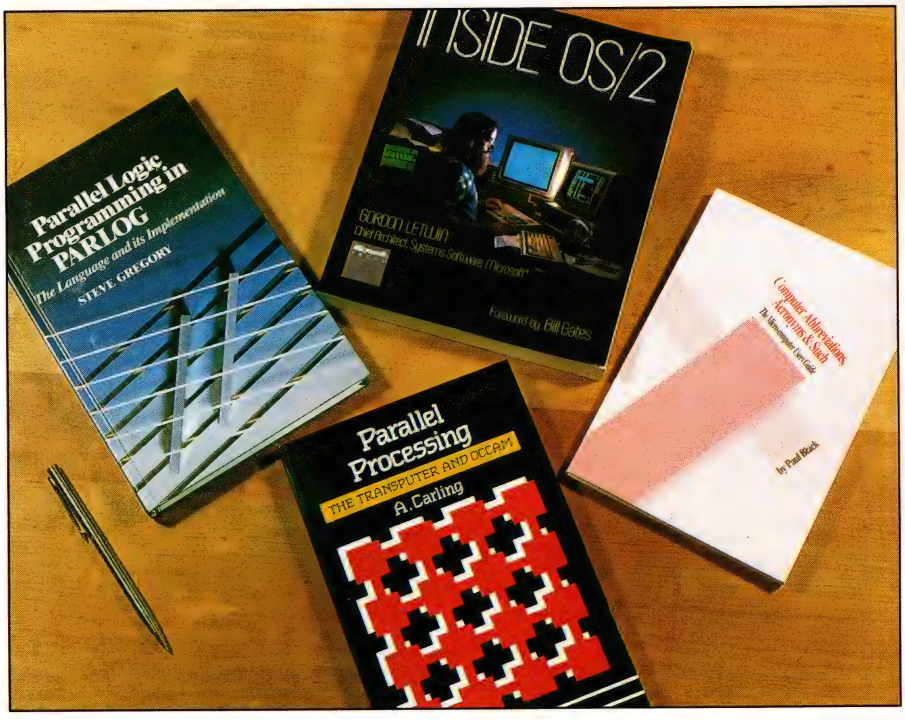
Author: Alison Carling
Publisher: Jacaranda Wiley
ISBN: 1-85058-077-4
Price: $46.65

Parallel processing is one of the most exciting fields in computing at present: as miniaturisation reaches its physical limits, the only way to gain computing speed will be the use of many processors coupled together. As a result, a great deal of research and development into parallelism is being carried out around the world. The book is divided into six parts: an introduction to parallel processing, parallel architectures, communications, software, and the transputer and occam (a language designed for the transputer). The first chapter gives a classification of parallel systems and talks about applications. The second describes a number of past and present parallel systems; exclusively American-based, with no mention of important contributions from the rest of the world. The communications section considers various hardware solutions to the problem of making multiple processors and memory talk to one another with minimal overhead. In the software section, we read about a number of languages adapted or designed for parallelism. The transputer chapter gives details of the chip's hardware and a number of applications. Finally, there is a tutorial introduction on occam.

What about the style and substance? Unfortunately, these leave much to be desired. The book reads like a collection of advertising blurbs and product descriptions with little discussion of the foundations of parallel processing. For example, one of the most important concepts in parallelism is deadlock (when two processes get 'stuck', each waiting for information from the other) but this feature does not even get a mention here.

More importantly, the book is riddled with errors. The occam tutorial is particularly bad: the indentation of an occam program is vital (changing the indentation of a program may completely change its meaning) and about half the example programs are incorrectly indented.

Alison Carling's book covers an interesting area of computing. However, because of the omissions and errors I cannot recommend it to *APC* readers.
N North



Parallel Logic Programming in Parlog

Author: Steve Gregory
Publisher: Addison-Wesley
ISBN: 0-201-19241-2
Price: $32.95

The major drawback at present to the use and implementation of parallel processing techniques, is the lack of a general purpose language that allows the manipulation of many processors simply. Occam, the Inmos transputer language, can hardly be considered a high-level language and only now are new implementations of C and Pascal being developed. This book describes the research completed by the Imperial College Parlog group in the UK and their method of implementing a Parlog compiler.

The original programming languages were imperative languages and reflected the internal architecture of the actual machines they ran on. The next stage in language design was to develop declarative languages which are based on abstract formalism. LISP, being based on the mathematical theory of functions known as lambda calculus, was the first major breakthrough in this direction. But it wasn't long before logic programming, based on sentences of first-order predicate logic, was becoming widely used through the language Prolog. The Parlog group was set up to use these logic techniques in a new parallel language.

This book begins and ends by explaining a little of the history of programming techniques and provides a brief survey of the current theory behind different types of possible parallel concepts. To these concepts it adds two further types which can be simply implemented in a logic language. Chapters two to four explain basically what facilities are available under Parlog for the programmer and how to go about using them. The rest of the book is aimed at those who want to design a Parlog compiler.

This is not a simple book. It is aimed specifically at communicating where the Parlog research currently is, rather than being a definitive guide to a new language. I think it will be a few more years before you'll be able to pick a Parlog compiler for your transputer system. But if you want to lead the race for implementing it yourself, pick up a copy of this book and have a go.

Dr E Hines

An Introduction to Distributed and Parallel Computing

Author: Joel Crichlow
Publisher: Prentice-Hall
ISBN: 0-13-481094-5
Price: $58.50

High-performance computers are increasingly in demand in areas such as structural analysis, weather forecasting, medical diagnosis, remote sensing, among many other scientific, engineering and other applications. Without 'supercomputers', many of these challenges cannot be made within a reasonable period of time. Achieving high performance depends on aspects such as faster and more reliable hardware, improvements in computer architecture and processing techniques.

This book is one of a number of texts to address this general area and is meant to be an introductory level course on the subject for undergraduate students. There are seven chapters in all. Chapter one is an introduction to all areas discussed in the text. Chapter two presents the ways in which computer systems have been organised to facilitate distributed and parallel computing. Chapter three gives an introduction to communications technology and computer networks. Chapter four discusses aspects of operating systems design for distributed and parallel computing. Chapter five deals with the popular client server model of distributed computing. Chapter six focuses on distributed database systems and chapter seven provides an informal introduction to some parallel programming languages.

All in all, the author achieves his objective as far as his target audience is concerned.

Dr E Hines

GENERAL

Inside OS/2

Author: Gordon Letwin
Publisher: Penguin Books
ISBN: 1-55615-117-9
Price: $29.95

Gordon Letwin knows a thing or two about Operating System/2. Mind you, he should. He is Microsoft's chief architect of the new 80286-based operating system. *Inside OS/2* charts the thinking behind OS/2 in three parts.

Part One covers the history of the product and its development from the background of MS-DOS. Goals were set for the function of OS/2 and a development method was selected. In Part Two the architecture of OS/2 is covered, which at 210 pages, makes up the core of the book. Multi-tasking, virtual memory, dynamic linking and the Application Programming Interface (API) calls are described in detail. No programming examples are given — but that is not the function of this book. Throughout, diagrams are kept to a minimum, but they are used to explain concepts that would otherwise be too complex to describe in words.

Unfortunately, neither LAN Manager nor Presentation Manager are covered to any great degree, although each of these merits a book in its own right. However, their virtual absence here does nothing to detract from the book's importance.

The book ends with a small section entitled 'The Future' that takes a look at the directions in which OS/2 may develop. The speed of change in the personal computer scene may bring these predictions to reality within the next year.

This is no dry tome that provides the facts with no fun. *Inside OS/2* is a mixture of historical account, philosophy and technical information, lightly sprinkled with some American humour.

Be warned, however, that some authors have simply plagiarised material from the expensive Software Developer's Kit, in order to make a quick book and a quick buck. Letwin is one of the many 'fathers' of OS/2, and his understanding comes through well in this book.

The great uncharted waters of OS/2 have been clearly mapped out by Letwin. In a highly readable style, he paints a detailed picture which makes this excellent book a 'must' for anyone whose work brings them into close contact with the mysterious OS/2.

M Wren-Hilton

Computer Abbreviations, Acronyms & Such: The Microcomputer Users Guide

Author: Paul Black
Publisher: Diflo Publications
ISBN: 0-7316-2289-8
Price: $14.95

In the world of computers, everything (or at least it sometimes seems like everything) is referred to by its initials. If you think up a new idea or form a new organisation, then make sure to select its initials carefully, so that they form a catchy acronym. That way you can be certain of success. And yet for those not in touch with what's going on, those initials and acronyms are confusing and frustrating.

So for the uninitiated, who are currently drowning in initials, abbreviations and acronyms, Paul Black has written a 'how to swim' manual. He has provided explanations for some two and a half thousand items of computer jargon. Most of these are initials or acronyms, but there are also words that have particular technical computer usage.

In most cases, the explanation consists of a single line or even just the words from the initials. This is usually enough, as most of the words appear elsewhere in the book. If not, they can usually be found in the Macquarie Dictionary. In some cases there are diagrams to help with the explanation.

Dr Black has provided an introduction which gives a quick overview of microcomputers. In this he also gives us some examples of the use of these terms and so demonstrates just how large numbers of initials can turn the language into an alphabet soup.

Unfortunately, books like this date quickly. Things that were not possible six months ago are now possible and new terms are invented all the time. Even the first edition suffers a little from this. For example, there are now read/write optical disks available but in the introduction they are treated as read only devices.

Overall, I found 'Computer Abbreviations, Acronyms & Such' a useful book. I hope that Dr Black hasn't stopped collecting these terms, because we will definitely need an update sometime next year.

J Horey

END

Comdek

Computers To Go

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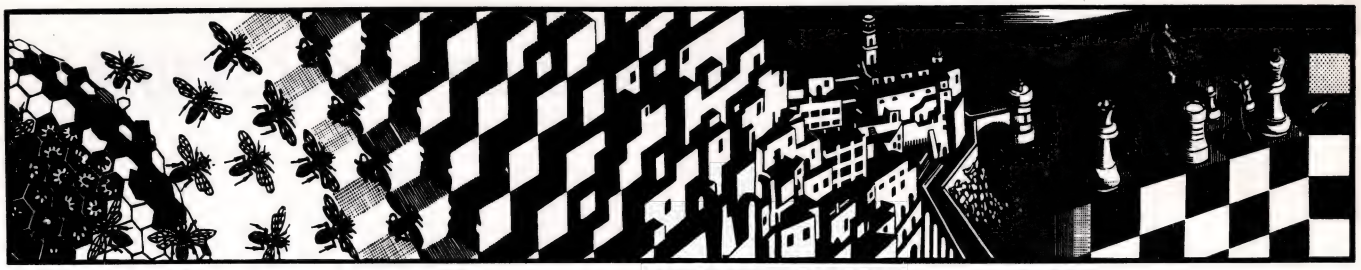




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AFTER DARK



An adventure game enters its second generation, evil Yuppies roam the Square Mile, and a 3-D flight simulator protects, among other things, the US Presidential jet, as Chris Cain flits through the best of this month's new games software.

Fighting over the Pacific

Title: F/A-18 Interceptor
Computer: Amiga
Supplier: ECP
Format: Disk
Price: $49.95

It has been quite a while since the pages of 'After Dark' were graced with the presence of an Electronic Arts product. Although the company claims to be 'Number One in the USA', its products of late haven't really measured up to the advertising hype on the box cover. However, its latest offering, F/A-18 Interceptor, looks set to pull it back into the charts.

Programmed by Bob Dinnerman, an ex-hardware designer for Motorola, F/A-18 Interceptor is a state-of-the-art combat flight simulator, putting the player into several simulated emergency situations.

The best way to start with Interceptor is to watch the demonstration flight. This runs through a seek and destroy mission and shows some of the skills that need to be learned before taking on one of the combat assignments. (It also makes a very good salesman when displayed prominently in a shop window, but that's nothing to do with this column.)

When you've signed up and read the Quick Key Reference Guide, the Free Flight option on the menu allows you to experiment and familiarise yourself with the plane. In Free Flight, there are no enemies to complicate life. Before you go anywhere, you're given a choice of starting location ranging from famous US military bases to aircraft carriers in the Pacific.

Depending on where you're based you can take control of either a General Dynamics F-16 Fighting Falcon or a McDonnell Douglas/Northrop F/A-18 Hornet. Both planes are super-modern jet fighters capable of supersonic speeds and equipped with a range of hi-tech goodies. There's really not much to choose between the two beasts but the Hornet, in my opinion, is the better looking.

Getting into the air is, thankfully, nowhere near as complicated a sequence as in a standard flight simulator. Just hit the throttle, wait until you reach about 200kts and then ease the joystick back. If you launch from an aircraft carrier, it's a good idea to employ the afterburners as you take off because the runway isn't that long.

All the action in Interceptor takes place in the San Francisco bay area and it's possible to fly around famous landmarks like the Golden Gate Bridge, Alcatraz, and the Pyramid; Electronic Arts has even included its own building. These are all depicted in solid 3-D graphics, as is everything in Interceptor.

When the basic controls of the plane have been mastered, you proceed to the training pad where you're taught basic combat manoeuvres. There are seven manoeuvres in all, ranging from simple flips and rolls to more complicated loops, spins and dives. These procedures are actually practised by real pilots and the training demo lets you sit back and watch each one as it should be done. When you're ready, you follow a computer-controlled instructor into the air and try to perform each manoeuvre in sequence as he does. This section can be skipped, but you won't get the full feel of the game unless you practise.

After a few more free flights it's time to try to qualify for active missions. Qualification is actually quite simple. All that's required is for the player to take off from an aircraft carrier, fly around and then come back to land safely on deck. Unfortunately, free flight and training are





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Interface	RS-232	PS/2 Port	PS/2 Port
Resolution DPI	300-1000	300-1000	300-1000
Button	3	2	2
Menu Maker	Yes	Yes	Yes
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Mouse Pad	Yes	Yes	Yes
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Moreover, the Window Cover-Sheet allows you to insert any utility template or drawing sheet; and the Genius software enables you to customize your own symbol menu library.

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The Genius Tablet GT-1212 package includes Genius Tablet with Puck, Auto CAD Template & Menu File, Genius Menu Maker & Menu Library, and DR. HALO III software.



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the only times you're 100 per cent safe from enemy fighters, so keep an eye on the radar for any suspicious-looking planes. (OK, any suspicious-looking Russian planes.)

When all this has been accomplished, you may attempt one of the built-in missions. Four assignments are presented at first, each requiring different tactics and strategies.

The first mission is Visual Confirmation. Your task here is to find and identify an aircraft and return to SFO unscathed. As the identity of the aircraft is unknown, all weapons systems are operational, making things much more fun. Both the F-16 and F-18 fighters are armed with short and medium-range missiles, plus a short-range cannon. (For the benefit of hardware freaks: the medium range missiles are AIM120A AMRAAMs which are highly accurate and have an effective range of over 48 kms.) The planes are also fitted with ECMs, flares and chaff decoys as standard.

The second mission is of a far more serious nature. Air Force One, the President's personal aircraft, is on course for SFO and there are hostile aircraft in the sector. Using an F/A-18 Hornet you must intercept the enemy planes and see that Ronnie gets down in one piece.

Other tasks include recovering stolen aircraft, a search and rescue operation and even chasing a renegade cruise missile. The latter is a really good one and quickly gets the adrenalin pumping as you race through the skies.

Apart from the heart-pounding action, Interceptor relies heavily on its graphical content. The solid planes, submarines, aircraft carriers and buildings enticed quite a few bodies into the *APC* office for a close look. Sound also contributes to the overall effect, especially the whistling of the wind and the kick of the afterburners.

Unfortunately, even a game of this stature has to have a drawback. The disk itself is not copy-protected, so safety backups can be made. However, before you get into the air you must find and enter a numeric code by lining up co-ordinates on a silly cardboard decoder wheel. If you only needed to do this once at the start of each session, it wouldn't be too bad but, no, you have to type a new code in for each flight and mission. Things like this drive me nuts.

However, it must be said that F/A-18 Interceptor is the flight simulation for the majority of us: easy control, addictive gameplay and state-of-the-art graphics and sound. A worthy addition to the Amiga's software.

One knight stand

Title: The Bard's Tale II: Destiny Knight
Computers: Commodore 64/128; Amiga
Suppler: ECP
Format: Disk
Price : C64/128, $34.95; Amiga, $49.95

'Beyond the Bard's Tale, as it was told, an epic great will now unfold, and in the quest, before thy sight, a mortal man becomes a knight . . .'

Well, at least we hope he will. This is the opening line of the poem introducing Destiny Knight, a new role-playing game from Electronic Arts.

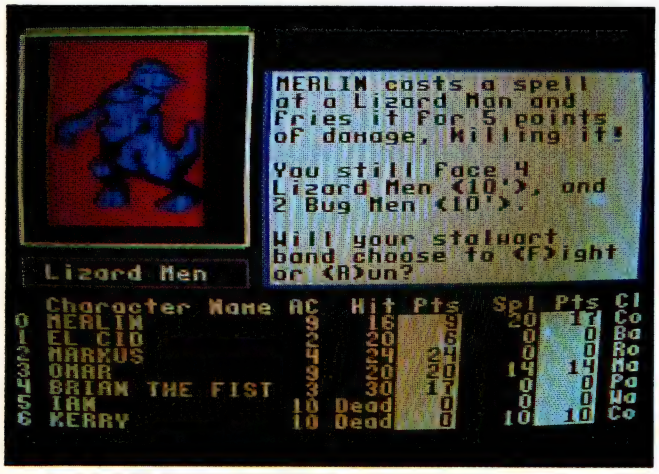
Destiny Knight is the next game in the Bard's Tale series. Years have passed since the days of Mangar, and tales of your courage in Skara Brae flow from the lips of every Bard in the realm. Since then, peace and prosperity have been maintained by a powerful charm known as the Destiny Wand. Forged by the Archmage Turin, the wand has quickly and easily aided the armies of the realm to defeat anyone who stood against them.

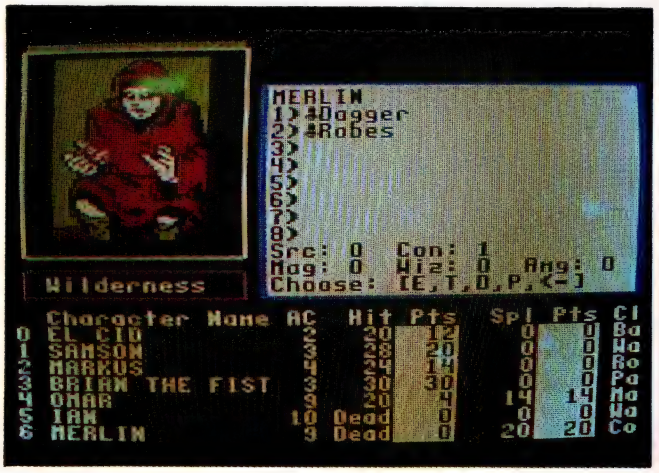
However, after recent reports of mercenary attacks, you learn that the wand has been stolen by Lagoth Zanta, a twisted and very powerful mage. Lagoth has used his great power to smash the wand and it now lies in seven pieces. Because it is impossible to destroy them completely, Lagoth has placed each fragment of the sceptre within a Snare of Death — a real-time puzzle room that requires a great deal of skill to survive. Leading your band of fearless warriors, you must regain the parts, defeat Lagoth and re-forge the mysterious wand. Then, and only then, will you restore the land.

Starting at the Adventurers' Guild, your first task is to assemble a band of adventurers. The members that make up your band needn't be human; there are several character types available. Once you have chosen the race of a character, you decide which class they will be in. Classes include Warriors, Paladins, Rogues, Bards, Hunters, Monks and Magic Users. The latter class is divided into five groups: Conjurers, Magicians, Sorcerers, Wizards and Archmages.

Each class has its own abilities and it is these you must learn in order to win. Dwarfs and Humans, for example, make good Warriors as both are strong and heavily built. Magic, however, is best left to those races which come from magical backgrounds, such as Elves, Gnomes and Hobbits. When the party has been completed, you can set forth on the quest.

The world in Destiny Knight is made up of six individual cities, as well as dungeons and forests. Starting in the capital city, Tangramayne, your first stop is Garth's Equipment Shoppe. Here you will find many of the essential items needed on your journey. Each being is created with a small amount of gold to their name, so the idea is to kit them out





with the best they can afford. As you acquire more gold, you can keep visiting Garth to buy more powerful weapons and supplies.

The screen display is split into three main windows. The first window, top left, displays a picture of your current location within the realm. This normally shows a scrolling 3-D street or dungeon but, when you face an opponent, their portrait appears here. These are beautifully drawn, some are even animated.

Next to the location window is the action window. This presents you with options and gives brief descriptions of where you are. Combat, a main feature in this type of game, is also controlled from here.

Finally, there is the party list showing, among other things, each character's name, class and current state of health.

Tangramayne is made up of houses, shops, taverns and several other interesting places. Using the mouse you guide your party through the scrolling streets of the city. When you get to a building you want to check out, simply move the mouse pointer over it and press the button. Entering a building results in a detailed display of its contents. Key places to visit include the Energy Emporium and the Starter Dungeon.

The Starter Dungeon in Tangramayne is the perfect place to build up your team's abilities and experience points. Almost everything in Destiny Knight rides on experience. The more battles you have and the more problems you solve, the more experience points you gain. When you have enough points you can visit the Review Board. Each city has one, and here you can ask the powers that be to put your characters onto a higher level, boosting their strength, stamina and agility. Magic users can learn new spells if they have enough experience and a bulging purse. Unfortunately, you have to appear in person at the Review Board, which means finding it first.

Combat is a popular pastime in fantasy role playing but here, unlike other computer games, the victor will not be the one with the fastest hands. Battles are fought taking into account all of the attributes possessed by the combatants. Spells can be cast by either side which completely turn around obvious victories or defeats. This type of strategy makes Destiny Knight lots of fun. In fact, it is so engrossing that you can often lose track of the real point of the game!

When each member of your party has reached level 14 or higher, it's time to venture out of the capital and into one of the other five cities and, of course, the Destiny Wand. The forest surrounding the six cities is huge and, as one would expect, highly populated with trees. It also contains a few wooden huts. One of these is the abode of a great sage who will help you in your quest: you should visit him every time you complete a dungeon. Be warned, however — his knowledge is not cheap.

Exploring the other cities is a tremendous task, and liable to take some time. But such is life in Destiny Knight. As you go on, you'll discover certain objects which the team doesn't recognise. These should be taken to a shop and identified as soon as possible because a lot of magical items exist. Something classed as an 'instrument', for example, may turn out to be a magical Flame-Horn capable of inflicting severe damage to an opponent when blown by the Bard.

Incredible artwork, 100 monsters, 79 spells, 25 dungeon levels, six cities, and the ability to import characters from Bard's Tale 1, Ultima III and Wizardry all make Destiny Knight one fantastic experience.

Yuppie morals

Title: Corruption
Computers: Atari ST, Amiga, PC and other versions to follow
Supplier: Questor
Format: Disk
Price $69.95

Masters of adventure, Magnetic Scrolls has built up quite a reputation for itself. Every new title is better than the last, a feat which very few software houses manage to perform. Here, on my desk at last, is Corruption, the latest from the Scrolls stables.

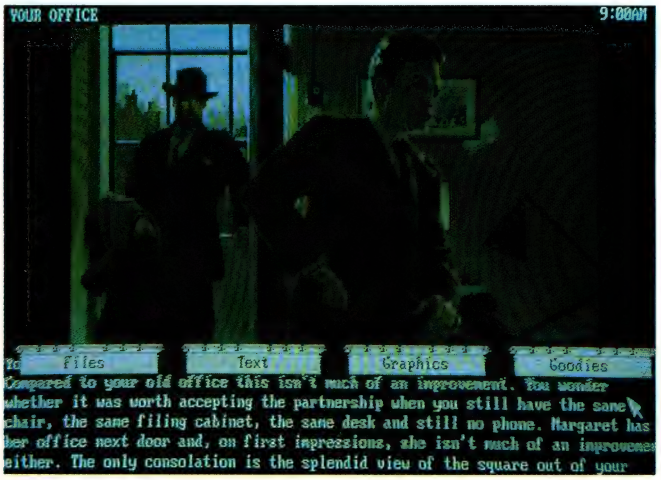
While adventures like Jinxter and The Guild of Thieves were mock-medieval scenarios, Corruption is set in the modern world of high-flying finance: the land of Yuppie, Porsche and handheld phones.

The plot follows the life of Derek Rogers, a young, upwardly mobile professional. Having just made good with a deal involving Scotts Electronics, Derek has been promoted to management level at Rogers, a highly successful stockbroking firm. He is welcomed into his new position by senior partner David Rogers and after a brief chat, Rogers becomes Rogers & Rogers. Confused? You will be.

The game begins in your new office, with David showing you around the building. The aforementioned office is in a terrible state, with an old chair, a battered desk and no phone.

An adjacent room leads out to where Margaret, your new secretary, sits. As the text freely admits, she's not much of an improvement either. Still, there's always your brand new BMW in the car park and you do have a nice view from your window. Further inspection of the building leads you to Mr Hughes, the company lawyer, David's secretary, Theresa, and Barbara, the cleaning lady.





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All seems to be going perfectly well until you suddenly feel a hand on your shoulder. The hand is, thankfully, connected to an arm: the long arm of the law. You find yourself arrested and brought up on charges of fraud — Section 178 of the Financial Services Act: Insider Trading (using inside information before it's public knowledge) — a very serious offence. Even with the best defence money can buy you can't get off, and are sentenced to a large helping of porridge. Time to start the game again.

This time you have an objective — find out who fitted you up and prevent them from doing it again. The first thing to do is to find the 'evidence' that was used against you in court, by choosing one of the many characters and following them. Following David leads you all over the place, and breaking into his office while he is away reveals a rather suspicious tape.

When played you find it's a recording of a meeting you had with him, but it's been edited to make you sound like a criminal. This recording is supplied in the Corruption package.

Side one is the original conversation, welcoming you to the firm. The other side, however, is totally different. For example, one of the sentences of the original meeting was: 'You can't buy me lunch, this one's on me.' The same phrase is used again on side two but stops half way through. 'You can't buy me . . .' This is cleverly done and adds a lot to the atmosphere.

Another piece of evidence is an affidavit claiming that David Rogers never had anything to do with the Scotts Electronics deal. Seems fair enough, but why does he need a sworn document indicating this? The plot, as they say, thickens.

Although the game isn't played in real time, certain events happen at set times of the day. Being in the toilet at, say 9.14, could allow you to witness a dodgy transaction.

Other people are the key to solving this mystery; you have to watch them like a hawk. Where does David go in the morning? Why won't Mr Hughes let you into meetings? Is David having an affair? What would his wife do if she knew? Is there any way you can persuade Margaret to make some coffee? These are the kind of things the player needs to consider when playing Corruption.

Character interaction is an important part of the game. Do something for someone and they may help you in return. Ask questions, bribe and even deceive people. Remember, in the real world the good guys rarely win.

As with all other Magnetic Scrolls games, there is a lot of wry humour in the text. Doing something totally normal like using a zebra crossing gives: 'You force a black cab to stop as you step onto the crossing. The cabbie isn't pleased, so you walk across very slowly just to annoy him a bit more'. Someone obviously knows me. Even the game's packaging hasn't escaped — the instructions and hints are in Filofax-compatible format!

Corruption is an incredibly complex game, with a vast playing area. I have only managed to cover a tiny part of it and I'm already hooked. I only hope the 'Amy' version appears soon so I can continue with it at home.

Anita Sinclair and the gang have proved, yet again, that they can match any Infocom blockbuster, and it's only a matter of time before Magnetic Scrolls is accepted as the top name in adventure games.

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GROUP ACCOUNTANTS

FEATURE

Selecting an accounting package

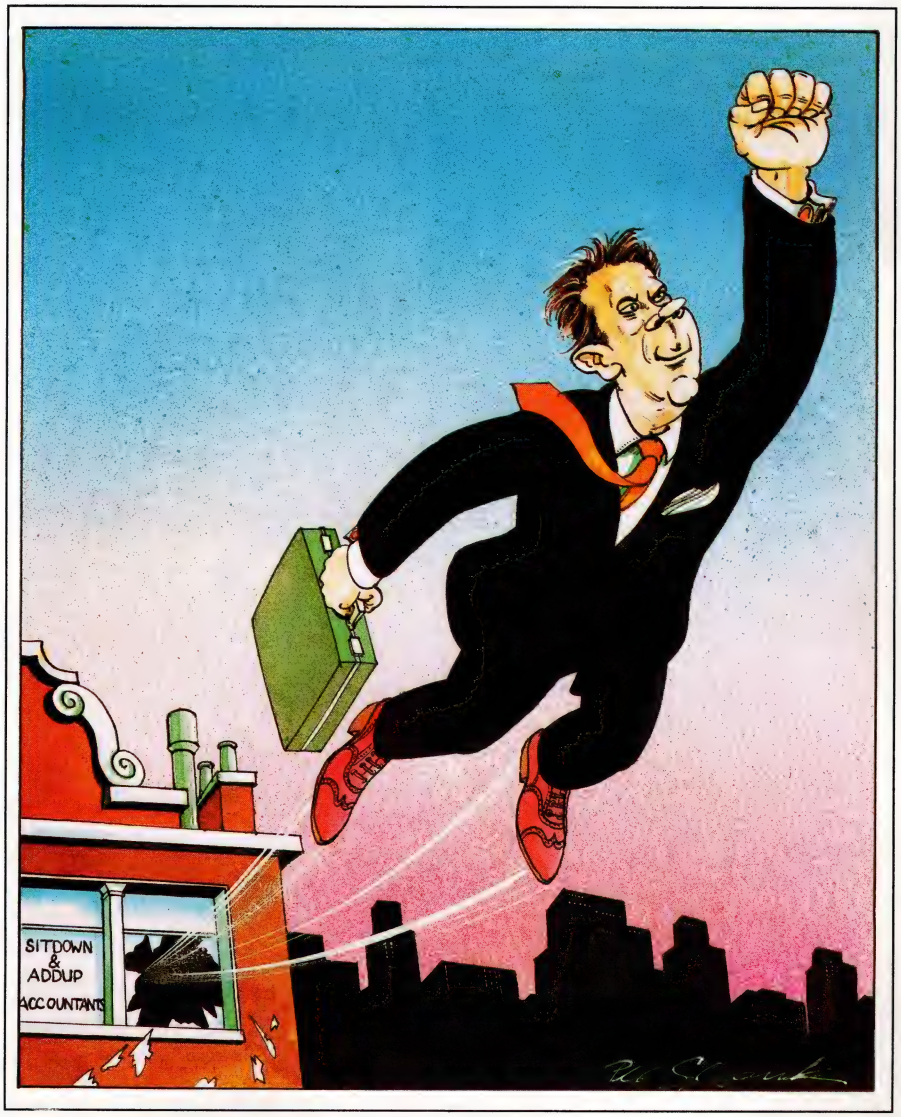
In the first article in a series of three, the 'Big Eight' accounting firm Touche Ross reviews a selection of accounting packages.

There are almost 200 microcomputer-based accounting packages currently available in Australia, and the range includes single and multi-user packages that run on a wide variety of operating systems and microcomputers. Touche Ross reviewers look at six packages which are designed to run as single-user systems on a PC and two which can run as either single or multi-user systems.

Subsequent articles in the series concentrate on reviews of multi-user packages. The packages have been grouped into single-user packages; multi-user packages based on MS-DOS compatible local area networks; and multi-user packages which run on other operating systems.

The review does not cover all available packages, nor does it single out any one package as the best available on the market. The most appropriate accounting package is the one that best suits the needs of your own business.

This article introduces you to some common accounting and computing terms to help you understand the 'computerspeak' often used by accounting system vendors. We have included a checklist of criteria to help you decide whether you can improve the efficiency of your business by transferring your



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current manual system onto a computer system.

Doing it yourself

No matter what language they are written in, accounting systems require training to be used effectively. Once they are learned and applied, they can make you more productive — if you have chosen the right package. Selecting the package that is right for your business first requires that you have a good understanding of your business needs and of the kinds of functions you want your accounting package to perform.

Choosing a package successfully requires an expert who can plan, select and, if necessary, develop an accounting and management information system appropriate for your type of business, implement it, and train you or your staff in using it. Very often, that expert will be your accountant.

Computerised accounting packages are not designed to replace accountants, but accounting packages which are designed for small businesses can often be operated satisfactorily by users with a small exposure to accounting procedures. There are several training packages currently available which are designed to help non-accounting types through the lower levels of financial accounting. One of these packages is called FANA (Financial Accounting for the Non-Accountant.

What makes FANA unusual is that instead of learning from a musty old accounting text, or taking time off to attend courses, one can switch on an electronic lesson.

FANA is available from Reckon Software for $199, and consists of five diskettes and a short manual. The manual covers exactly what is on diskette, and is necessary only for reference. Topics covered include 'The Nature of Accounting', 'Financial Statements', 'The Accounting Cycle', 'Funds Flow Statements' and 'Analysis of Financial Statements'.

The coverage of these topics is solid and comprehensive, but has one disadvantage in that it is written for the UK environment. For example, the UK Statements of Standard Accounting Practice are covered instead of the Australian Accounting Standards set by the Australian Accounting Standards Board. However, this is not a drawback as the fundamentals of accounting are covered well.

The software is very user friendly and no knowledge of PC's is required. FANA can be recommended to two groups of people: novices who know nothing about accounting and others who may know the fundamentals of bookkeeping, but who lack knowledge of the overall accounting framework.

Why computerise?

Accounting software currently available for PCs gives small businesses access to management information at a level of sophistication previously available only to large businesses operating mini or mainframe computers. Gone are the days where you had to wait weeks or months for your accountant to produce even the most basic financial reports.

Here are nine basic reasons to computerise your accounts.

Internal control and efficiency The introduction of standardised procedures required by a computer accounting system will improve internal control and efficiency of operation.

Management information Computer accounting systems provide accurate and timely management information relevant to user requirements.

Customer service Improved customer service is possible with the availability of immediate enquiry facilities.

Expansion capabilities A good accounting system will be able to expand to meet your requirements with the addition of further modules and user features not previously utilised.

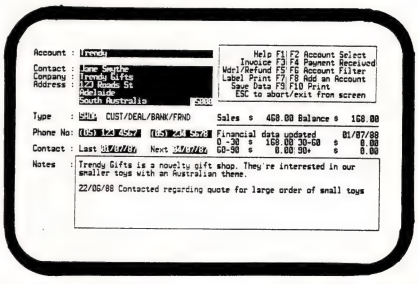
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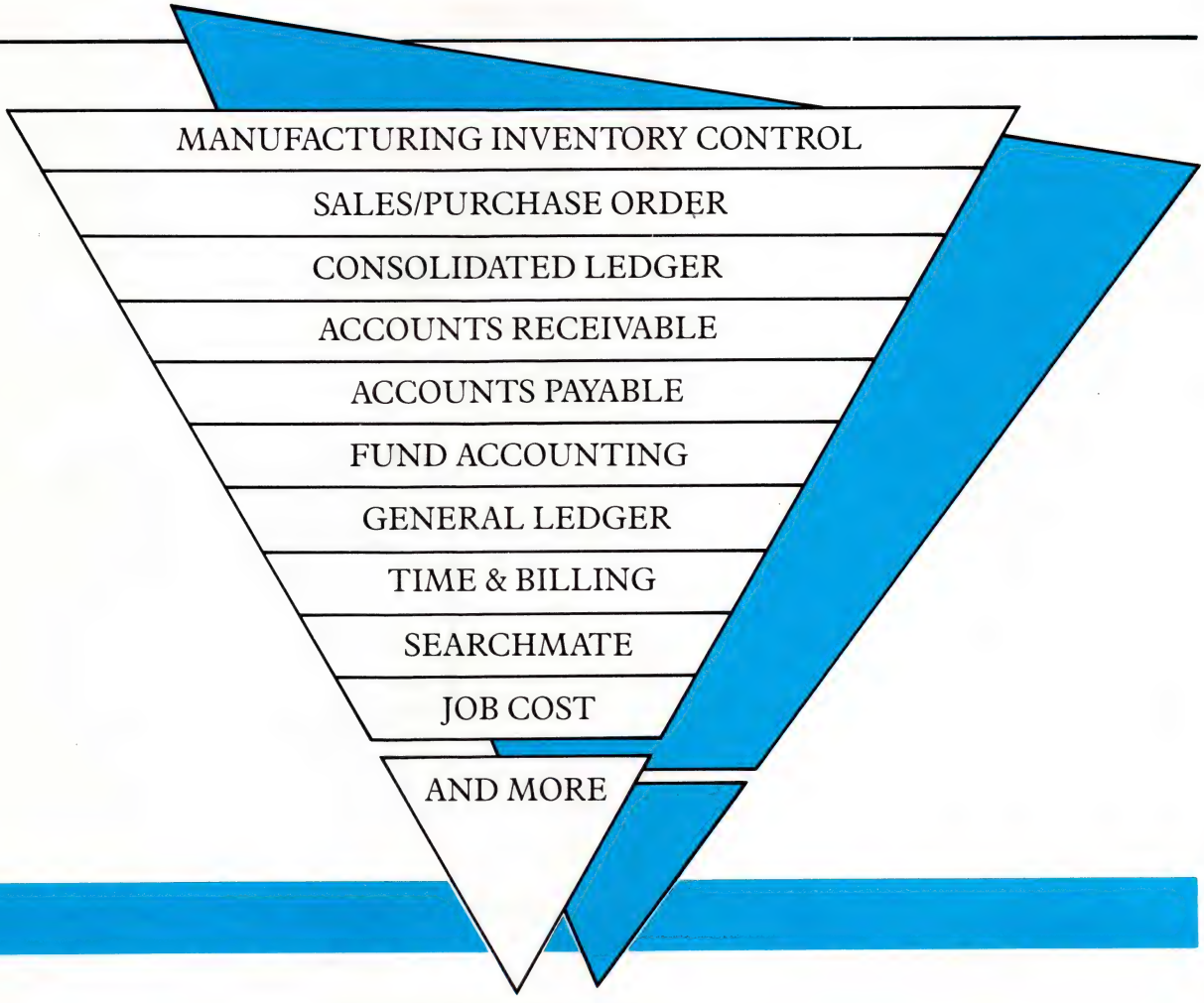
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Financial reporting All the information has been keyed into the system — financial reporting is then available at the touch of a button, at any time.

Integration Only one accounting entry for each transaction is required for all ledgers, realising tremendous time savings due to the integration of different ledgers within the accounting system.

Support and training Well-supported accounting systems with a developed training environment result in a proficient and reliable use of your accounting system.

Audit trail A greater audit trail of business operations is possible when your accounts reside on a computer system.

Security Security of accounting records is a major benefit of using computers, with the introduction of password control and user access.

Checklist

Buying and implementing accounting software isn't an easy job, but the impact of computerising your accounts can be enormous. Therefore, it is a good idea to work through a checklist to ascertain why you need accounting software and what you hope to benefit from it. Consider the following questions.

1. Are my staff and I familiar with using microcomputers?

If your answer is 'yes', you are over the first hurdle. If your answer is 'no', you should consider the ability of your staff and yourself to learn about and use microcomputers, as well as the new accounting system.

2. Do my staff and I currently operate a fully operational manual accounting system, including production of financial statements?

A 'yes' answer may mean an easier conversion to a computerised system than a 'no' answer.

3. Do we just run a cash book and maybe a trial balance at the moment?

A 'yes' answer indicates that you may need to consider the ability of your current staff to cope with a computerised accounting system.

4. Will my business be heavily dependent on the new system — could I go broke if the system broke down?

A 'yes' answer underlines the importance of setting up a hardware system that includes adequate processing back-up and data security. For example, if you were operating a business with on-line telephone sales and you require a seven day billing cycle to maintain cash flow, a badly designed system that is out of action for too long could cripple your business.

5. Do I have more than three accounting staff?

If 'yes', there may be some benefit in automating the accounts.

6. Does my existing manual system adequately manage my debtors, creditors and cash flow? Does it produce financial statements early in the next month?

If your answer is 'no', you should consider a computer based accounting system.

Your answers will indicate the extent of your need for outside assistance in selecting and implementing a computer-based accounting system. In any case, the checklist will help you reassess your initial investment plans to ensure the successful implementation of the computerised accounting system. As a general rule, there is a small price differential between the various packages. In addition, the cost of buying a package is usually a small component of the final investment in time and money required to successfully implement a computerised accounting system.

Computerised accounting terminology

Selecting your software can be daunting and even intimidating. People often find themselves outside the business they understand and are comfortable in, and are plunged into a world of jargon, overblown claims and inexperienced salespeople. Get to know the terminology. Here are just a few main phrases you should become familiar with.

Adjusting journal entries Transactions entered at the end of an accounting period to adjust general ledger accounts so that they represent the true financial position of the company. These correct errors, record revenues or expenses, or adjust the ledger for amounts that should have been spread over two accounting periods.

Ageing Categorises accounts payable or accounts receivable invoices by the number of days from the date that they were due for payment or collection.

Audit trail A log of transactions processed showing old and new status; also a history or journal of transactions which permits the system to validate and verify the data maintained in its field.

Balance-forward method All transactions for the previous accounting period are summarised into one amount, the balance forward. All transactions for the current period are listed and added to the balance forward to create a month-end balance.

Chart of accounts The accounts that make up the general ledger. An account is made up of a description and a unique number to which transactions (journal

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entries) are posted, once they have been entered into the system.

Current-year data files Information that applies to the current year's accounting activities such as transactions, budgets and month-end balances.

Double-entry accounting A method of recording accounting information in which the positive amounts (credits) in a transaction equal the negative amounts (debits). The sum of all the account balances in the chart of accounts will be zero if the transactions are posted properly.

Downloading To transfer information stored on a PC onto a disk or tape.

Enhancements and upgrades Application software vendors typically approach development of their software as an ongoing process of refining and adding new features (enhancements), especially when a more advanced version (or upgrade) of the language in which the application is written is released. The difference between an upgrade and an enhancement usually depends on who you are talking to. Most accounting package vendors charge an annual maintenance fee which covers system upgrades and enhancements.

Force zero proof option Requires a group or batch of transactions to balance (debits equal credits) before it can be accepted as valid.

Generally accepted accounting principles (GAAP) A collection of standards, interpretations, assumptions and methods followed by members of the accounting profession to ensure that financial statements for all companies are consistent from year to year and consistent from company to company.

Maintenance fee Usually an annual charge by the software vendor which is additional to the price of the package. The maintenance fee generally ranges between eight and 12 per cent of the purchase price and covers upgrades and enhancements.

Module The ledgers which make up an accounting package are often called modules. For example, most packages have general ledger, debtors and creditors modules. When modules are integrated, that means the general ledger is updated automatically by transactions in the other ledgers.

Open items Only unpaid transactions remain in the customer's account. Subsequent cash receipts and adjustments are applied to a specific invoice and the invoice is to be paid in full before removal from the system.

Package Almost all accounting software for microcomputers is sold as a ready-to-install bundle of modules. The term package refers to a suite of computerised ledger shells and other programs.

Prior-year account history Information such as transactions, budgets and month-end balances that apply to the accounting activities in the year prior to the current accounting year.

Prior-year amount Dollar amounts posted to the chart of accounts in the year prior to the current accounting year.

Reversing entries Entries made at the beginning of an accounting period to undo the effect of adjusting entries made in the prior period. Accrued items, such as income earned but not received, are reversed so that only the amount belonging to the current period will remain in an account.

'Split-transaction' procedure Posting a single amount to one general ledger account while posting the other side of the transaction to multiple accounts. For example, many packages allow you to post an entire invoice amount to accounts payable and then post the other side of the entry to one or more expense accounts.

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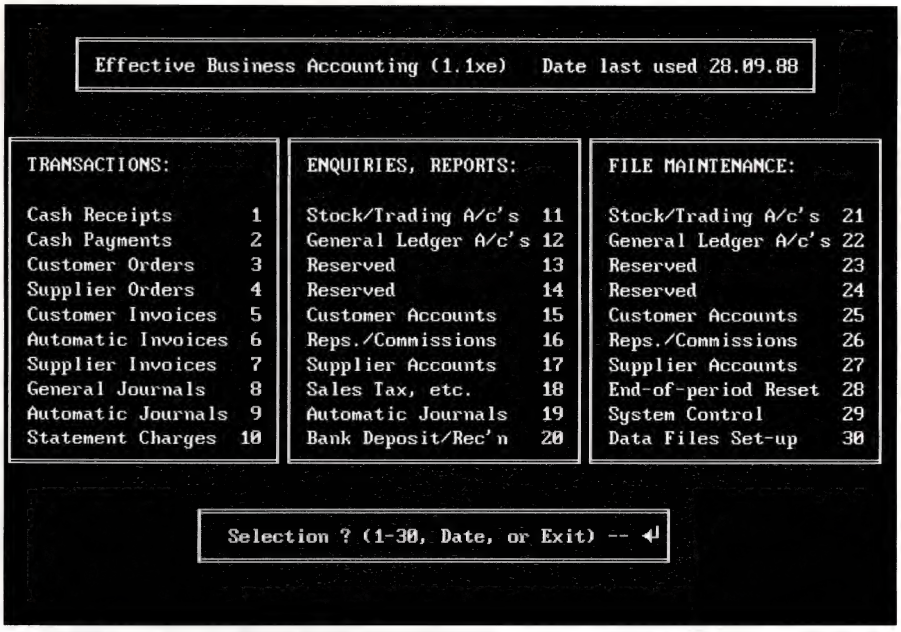
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The distributor of Effective Business Accounting, Wyong Business Systems (WBS), was originally formed some eight years ago to provide accounting support and assistance to small businesses. EBA was developed three and a half years ago and converted to run under MS-DOS a year later.

Up until July this year, support for the system was provided, under agreement, by another software house. This arrangement was terminated when WBS concluded that customers were not receiving adequate support.

WBS has taken on the task, and expanded its staff to support the package to the level they believe is appropriate.



The main menu screen of Effective Business Accounting

General impressions of the software

EBA has been designed for small- to medium-sized organisations requiring a single-user PC system. It is based on the balance forward accounting method. The package covers four functional areas: debtors, creditors, inventory and general ledger.

In addition to the standard EBA package, there is a manufacturer's version which includes a bill of materials module. The supplier's recommended price for this version is $699, but we were told some dealers and distributors charge more. WBS is also willing to make, for a fee, any customised changes users require to the package.

EBA is well suited for the first-time computer user. The documentation is comprehensive and easy to read. One feature we particularly liked was the two sections providing an introduction to computers and an introduction to accounting.

Both of these sections will benefit the novice user, but we must stress they are not a complete substitute for formal training. Their inclusion in the documentation reflects the total service package the supplier offers to small businesses.

The design of the menu makes EBA particularly easy to use. The main menu is split into three sections: transactions, enquiries/reports and file maintenance. Within these sections, each functional area of the system can be found.

An extremely useful feature of the package is the 'peek' function. This allows the operator to make enquiries on customer accounts, suppliers, inventory items or the general ledger while entering invoice details.

This facility will only work if the personal computer contains a graphics card.

Registration and upgrades

We encountered no major difficulty in installing the software. Our only problem stemmed from trying to read the manual too quickly. Once we contained our haste and spent a bit more time reading the installation instructions, the process became simple.

The supplier uses a novel approach in marketing the package. Instead of paying the full price of $699 up front, a prospective user can purchase the system for $99. This 'prelude' version of the system will allow a maximum of 100 general ledger accounts and 25 suppliers, customers, etc to be entered into the system.

The idea is that you can trial the package, in your own time, to see if it really suits your business needs. If you decide

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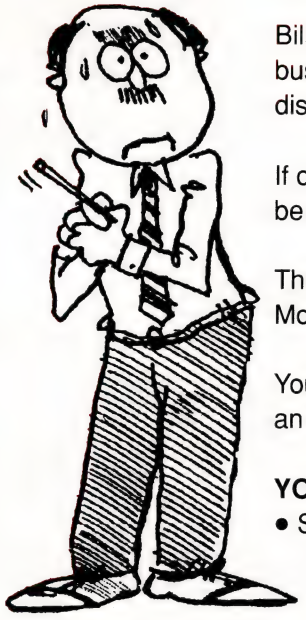
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it is the package you want, you simply pay the remaining $600 to have your version registered. The supplier then sends out the key which allows you to expand the system to fully cater for your businesses needs. If you decide you really do not want the package, you are only out of pocket $99.

The majority of sales of the package are made through dealers and distributors. The purchase price entitles you to three months free hot-line support. Additional hot-line support can be purchased for an annual fee of $120.

Upgrades of the package are released periodically. Registered users are sent details of the new release and are given the option of purchasing it. The price for each upgrade varies, but we were told the most recent one costs $120.

Capacity

There are no effective limitations on the size of the data files as long as you have enough hard disk space. When setting up the system, you are asked to estimate the maximum number of transactions so that the files may be created. The suppliers recommend that these estimates be conservative to reduce the amount of time spent backing up the data files. Once the number of transactions exceed the limits imposed by the size of the files, it is an easy job to expand them.

Each transaction processed through accounts receivable, accounts payable and inventory is automatically posted to the general ledger. At that point, a record of the transaction is placed in a history file within the general ledger. This file holds a maximum of 32,000 entries and is cleared monthly, so it is the limiting factor on all transactions processed though the system in a month.

Review of modules

Debtors EBA has several particularly good features in this area. Up to five sales commission rates are supported, and the user may set bonuses on particular stock items. Cash received may be paid against a customer or it could be offset against a general ledger account such as Bad Debts Recovered or Sundry Income. It also allows automatic invoicing. The debtors module is of a high standard and like the rest of the system, is easy to use and understand.

Creditors The creditors module adequately handles most trading needs. There are not as many reports available as in other parts of the system, but what is available enables the user to effectively control the business.

EBA does record which stock items are on order from creditors but it does not record which creditor will supply the stock. This must be managed outside the system.

The 'peek' function is available during the processing of cash payments and supplier invoices.

Inventory Stock records may be called up using either the stock item number or the more meaningful short name. The system is quite flexible, in that up to four prices may be defined for each product. It also has four special types of stock item:

- normal stock items which deplete as they are sold or issued;
- non-depleting items such as labour;
- variable items for use in temporary products which will be bought then resold almost immediately; and
- narrative items which can be used for tasks such as reducing typing repetitive messages on invoices.

A comprehensive range of reports are also available from this module.

General Ledger The general ledger receives information posted automatically from the other modules of the system. It supports automatic as well as manual journals. All the reports produced by the module may be requested at any time during the month. The general ledger contains all the features you would expect in an accounting package of this size and appears to adequately perform all functions.

Conclusion

The system requires either an 80 or 132 column printer. A dot matrix printer is sufficient and the system has no unusual requirements regarding special stationery for forms such as invoices or statements.

Effective Business Accounting provides excellent value for money. Its recommended retail price of $699 is very competitive and the support offered by the

At a glance

Effective Business Accounting
Supplier: Wyong Business Systems
Tel: (02) 73 2269
Price: $699
Requires: 256k RAM, hard disk optional but recommended, CGA graphics card optional but recommended, PC/MS-DOS 3.1 or later.
In short: Modules available are Debtors, Creditors, Inventory and General Ledger. A well-designed and comprehensively documented package.

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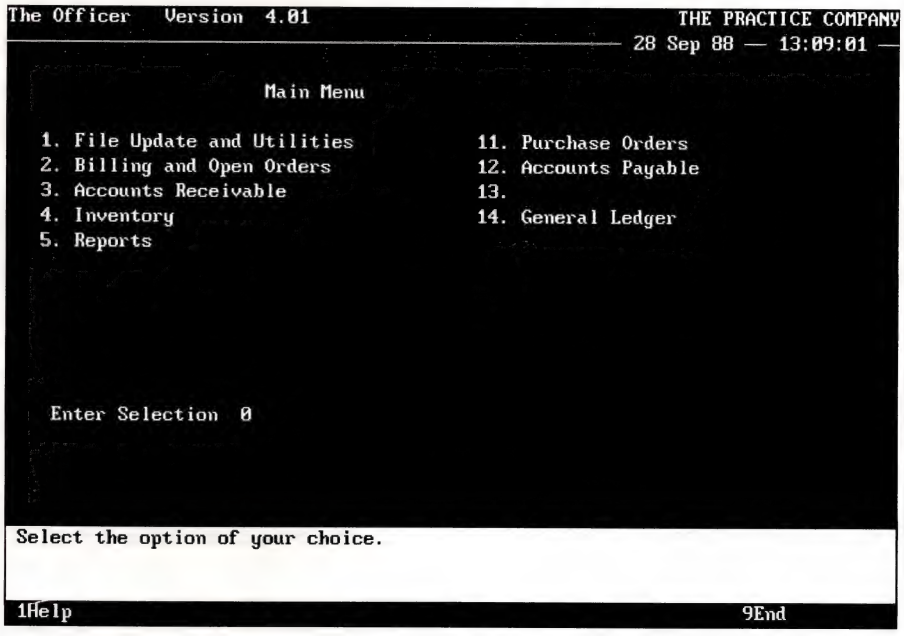
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The main menu for The Officer is similar to that of The Officer Cadet

supplier is comprehensive. The most attractive features of the package are the 'peek' function, the quality of documentation and the structure of the menus. Like all packages it does have some limitations, but these are, in general, outweighed by its good points.

The Officer Cadet

The Officer Cadet and its big brother, The Officer, are the result of a joint venture between Management Control Systems (MCS) and Business Systems Resources of the US. Originally developed for the American market, MCS has modified the package to suit Australian conditions and it has been available in Australia since June 1985.

Functions

The Officer Cadet is effectively a cut-down version of The Officer accounting system. The Cadet provides similar facilities, but excludes the order processing modules of the Officer. The functional areas covered by the Officer Cadet are invoicing, inventory control, accounts receivable, sales analysis, accounts payable and general ledger.

A distinct advantage of purchasing the Officer Cadet is that if your company out-grows the package, the upgrade path to the larger, multi-user Officer is quite simple.

One notable feature of the Officer Cadet is the online help facility. It is quite extensive and the operator, by pressing the Help key, can be told where they are and what options are available to them at that point. Where the Help function cannot provide enough details on the screen, a reference is given to the user manual for further information.

Like many packages we have reviewed over the years, the Help facility has not been extended to all parts of the system. However, it is available where it is needed — the most and many competing systems do not have the feature at all.

The user manual itself is quite well set out and again, it is very easy to find your way through. It is probably not quite as comprehensive as some other manuals we have reviewed but we do not believe this is a major drawback.

On the whole, we found the system easy to use and it did not take us too long to find our way around the menus. Two features were found to be annoying. Firstly, in some points in the system function key 3 returns you up a level through the menus, while in other points function key 4 does this.

Secondly, the bottom line of the screen tells you what function keys to use to delete or escape from the screen. Unfortunately, the key to save changes you have made to a record is not shown there. It is clearly described in the manual, but for the novice user it would be much better if it was displayed on the screen.

Registration and upgrades

The system has the ability to process up to 99 different companies. There are no

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interface technology of Australia
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55 Blaxland Road, Ryde, NSW 2112

At a glance

The Officer Cadet
Supplier: Management Control Systems
Tel: (02) 387 4533
Price: $2260
Requires: 256k RAM, 10Mbyte hard disk, DOS
In short: Modules available: General Ledger, Accounts Receivable, Accounts Payable and Inventory.

Context-sensitive help is readily available. Documentation is not as professional in appearance as other packages reviewed. Easy to use and powerful package.

effective limitations on the size of the data files, as long as you have a big enough hard disk.

MCS installed our test copy of the system, a service they offer to all customers. The instructions for installing the system yourself are quite detailed, but require a certain level of computer literacy. The system requires an extra board to be installed in the PC. This further complicates the installation process.

MCS offers a high level of support, from system installation, to staff training and general support as required.

Review of modules

Invoicing The invoicing function has all the features you would expect from an accounting package. In particular, it provides: online credit checks during data entry; flexible pricing and discounts based on customer categories; cost and profit calculation for each order; freight, special charges and sales taxes; multiple page invoices; daily back order reports; and sales commission reporting.

Inventory Control The key features of the inventory control module are: maintenance of average and last cost; an automatic interface from the invoicing functions; multiple pricing structures; and on-hand, on-order and allocated balances.

Accounts Receivable The accounts receivable module features online customer balance enquiry; maintenance of open item and balance forward customers; partial payments on invoices; automatic updates by the billing system; automatic late charge calculation; automatic account ageing; and future dated invoices.

Sales Analysis The sales analysis module draws on the information held in the billing and inventory functions of the package. It provides reports which allow management and sales staff to: analyse sales volume; review sales and profitability for items and customers; compare current sales with last year to spot emerging trends; and review each salesman's performance.

Accounts Payable The key features of this function are: cash or accrual accounting; automatic interfaces to general ledger and inventory; facilities for prepaid invoices; ability to make partial payments; and a summary of cash requirements.

General Ledger This comprehensive application includes on-line general ledger account enquiries; budget amounts for each account for the current and the previous year; separate records for multiple companies; consolidated statements across departments or companies; user formatted financial statements; multiple period general ledger posting; and a standard chart of accounts which may be tailored to specific needs.

Conclusion

The package uses standard 14.5in by 11in inch computer paper, so you will

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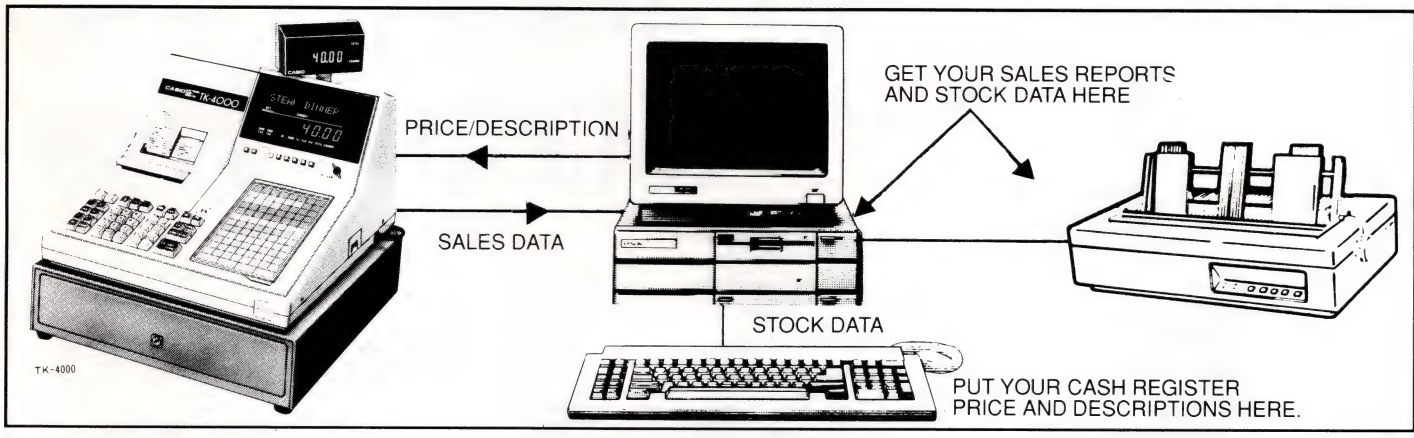
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need a printer with 132 print positions. Sample layouts are provided with the user manual for the pre-printed forms such as invoices and statements, so you can arrange to get them printed by a stationery supplier.

The Officer Cadet is a fast, user friendly, fully integrated accounting package that would suit many different business applications. Its screen display, help facilities and overall packaging make it a very attractive system.

Finally, the upgrade path to the larger Officer system makes The Officer Cadet a good choice for those businesses that expect to grow in the foreseeable future.

Fiscal

Fiscal is a well presented, single-user, user-friendly accounting package. It comes complete with sample data, sample reports, a primer, a two-volume users guide and four diskettes. These refer to an earlier revision of Fiscal and must be read in conjunction with the version 5 addendum. The excellent manuals and documentation provide direction and details for implementation. Fiscal is written in Pascal.

Fiscal Business Software consists of six modules in total: debtors ledger, creditors ledger, general ledger, stock management, cash management and sales analysis. Fiscal is described as a fully integrated sales control and ledgers system. Modules may not be purchased separately, however, for standalone purposes.

A particularly nice feature of Fiscal is the query facility, which is used to locate any account or transaction. By simply entering a question mark, and paging up or down through the displayed list, the user can easily find the required data.

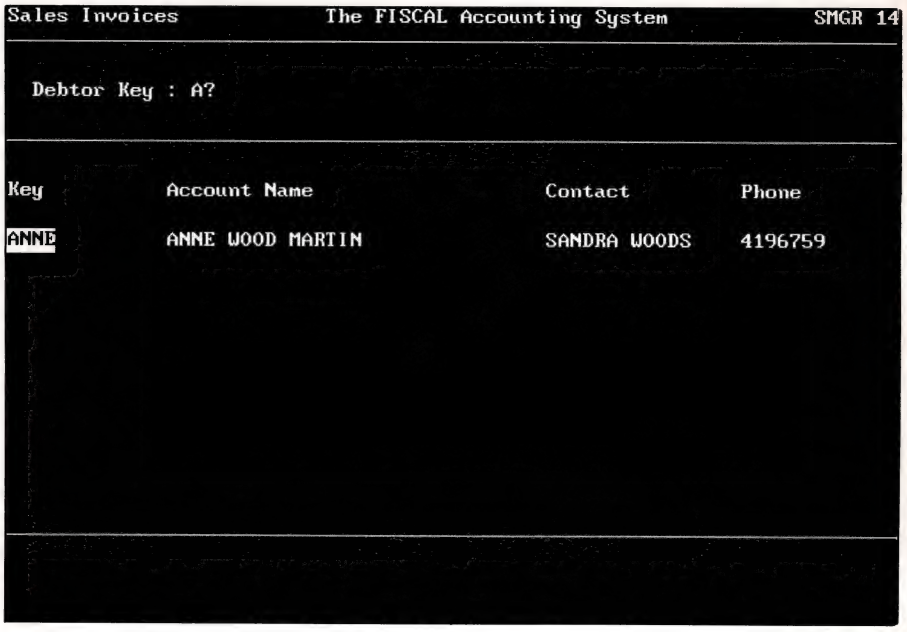
Online help is available throughout the entire system and indicates useful page numbers in the user manual for further reference.

Other features of Fiscal include password protection, comprehensive data auditing, multi-company processing, diagnostic facilities in the instance of computer failure and the ability to support multiple printers (up to five printers may be used simultaneously.)

The current version of Fiscal is 5.04 and its multiple company facility supports up to six companies.

Review of modules

General Ledger Fiscal's general ledger provides the following features: a default chart of accounts which may be used on initial setup; an unlimited number of accounts; automatic alternate accounts



A screen shot of Fiscal showing the menu selection feature

can be specified to highlight negative balances; six different methods of budget entry; transactions processed in batches for improved control; the origin of transactions posted automatically from other ledgers may be checked by means of a source reference; and a transaction history for each account may be maintained for up to 12 months.

Debtors In this module, quotations can be accepted and converted to orders without additional data entry and they can be prepared and printed with automatic pricing and discounts. Customer orders will automatically reverse stock items or place the items on back-order if the stock is not available. The option is given to print picking slips for despatch. The total invoice weight can be calculated for determining freight charges and invoices, and statements can be printed on a number of different forms. A queue facility may be used for later printing. Receipts from cash management automatically update customer and invoice balances and orders, and invoices and credit notes update the quantity on hand and the quantity available for each stock item.

Creditors Fiscal's creditors module provides the following features: open-item accounting; purchase orders can be prepared and printed for suppliers; ordered items are tracked until supplied to avoid reordering; invoices can be generated automatically from orders when goods are received; cheques from cash management automatically update supplier and invoice balances; purchases and credits update the general ledger accounts without further data entry; and orders, invoices and credit notes update the quantity on hand and the quantity on order for each stock item.

Stock Management Each stock item can be assigned up to three levels of pricing for automatic invoice calculations. Global price changes can be made at any time for a group of items based on margins, price levels and existing costs. Other features: fractional stock quantities and values may be used; inventory may be valued at either replacement or average cost; and stocktake forms can be printed in item or bin location order.

Cash Management The cash management module allows every cheque and receipt to be divided into 50 expense or income accounts. It also allows for up to nine bank accounts to be controlled; cheques and receipts allocated to creditor and debtor accounts and also

At a glance

Fiscal
Supplier: Arcom Pacific
Tel: (07) 369 8900
Price: $1950
Requires: 256k RAM, hard disk, DOS 2.0 or later
In short: Modules available: Debtors, Creditors, General Ledger, Stock Management, Cash Management, Sales Analysis. Attractive documentation. A mature, comprehensive single-user package.

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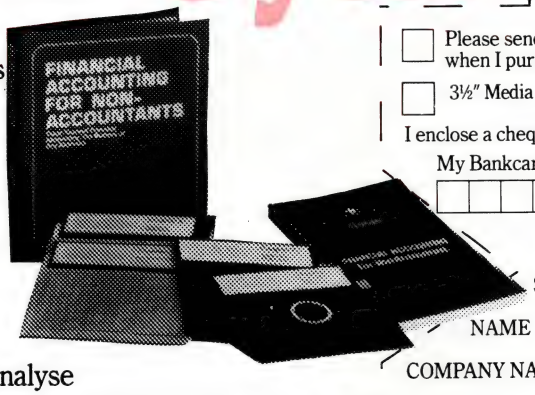
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general ledger expense and income accounts; and cheques and receipts to be reconciled against bank statement.

Sales Analysis Sales analysis provides the following features: unique graphics selection to display sales comparisons in simple graphical format to examine term trends in sales, profits and cash flow; additional reports to analyse customer performance, stock movement and supplier turnover; sales tax return and analysis report; sales invoices and credit notes entered in the debtors; and ledger automatically updates the allocated sales area.

Conclusion

Fiscal can be used with any type of printer that connects to the serial or parallel ports of a PC. This includes 10in and 15in versions of the IBM printer, in addition to a wide range of other printers.

Stationery for printing sales invoices, credit notes and statements is available to suit both 10in and 15in carriage width printers. If processing backorders, a 15in carriage printer should be used since the wider sales invoice stationery shows backorders and order tracking information.

Fiscal is a well presented, well documented package. The manuals are written with the non-technical user in mind, without lacking essential information. It gives every impression of being a mature, comprehensive, flexible single-user product.

Integrated Business Support

The IBS accounting package is a multi-user, multicompany package written in dBASE III for finance companies. IBS consists of eight modules in total: Inventory, order processing, accounts receivable, accounts payable, general ledger, personnel management, job costing and finance management. It is described by the supplier as a Business Management and Accounting system for PCs. All IBS modules are fully integrated (ie, no duplication of data entry is necessary), but may be purchased individually for standalone purposes.

The IBS automatic post facility allows data transfer to and from the IBS system, from data files stored in dBASE III format. Data may be accessed from most spreadsheets (ie, Lotus 1-2-3, Framework II etc) or databases that are dBASE III compatible. Other IBS facilities include a pop-up calculator, online help for each feature of the system, a multi-level report writer and a search utility by alphabetical flag.

The entire IBS package consists of four diskettes, a user manual and brief installation notes. Initially, IBS may seem deceptively small, since files are efficiently archived, unlike the average accounting package which provides separate diskettes for each module. Installation of IBS is not a simple task and may prove complicated for the non-experienced user.

The user manual is poorly presented and lacks colour, style and finish.

The IBS system is fully integrated whereby all subsidiary ledgers integrate directly to the general ledger, thus avoiding duplication of data entry.

Registration and upgrades

The current version of IBS may be used on IBM PC-based single-user or NETBIOS compatible LAN-based multi-user systems. No limit exists on the number of companies that may be processed, provided enough hard disk space is available (at least 1.5Mbyte of hard disk

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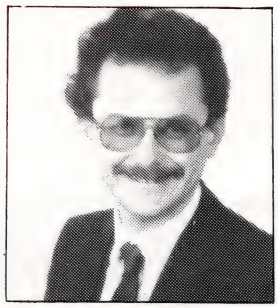
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Demo packs, which contain the manual and complete program are available at only a fraction of the price. Not just a fancy scrolling display with impressive graphics but the real program. Actually test it out on your own computer! If you like the program you pay the balance of the price.

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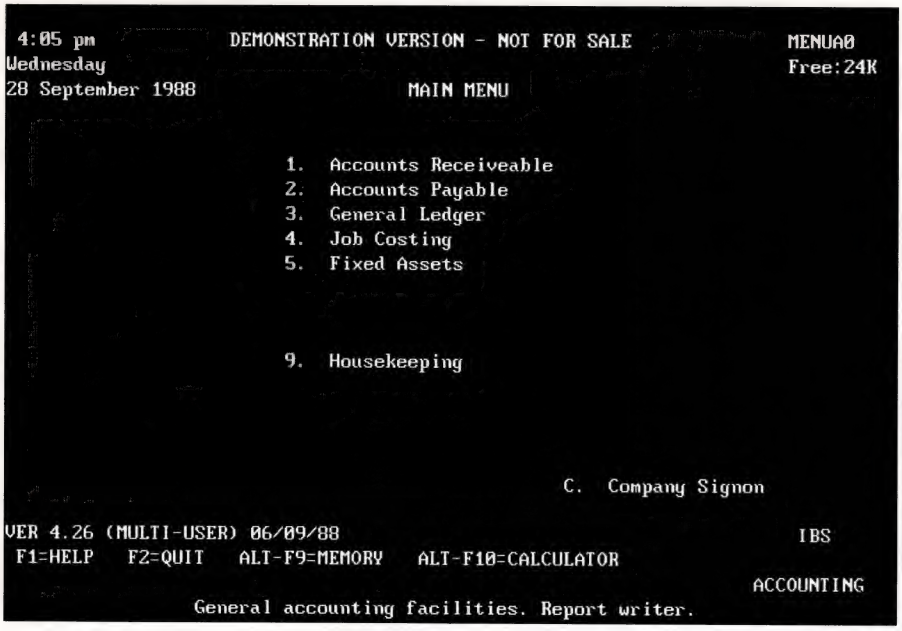
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The main menu screen of Integrated Business Support. Note the calculator option

space per company). Company consolidation (aggregation of balances) is available for each company set up in the system.

Review of modules

General Ledger IBS General Ledger module provides the following features: ability to process standing journals; variable chart of accounts; and a report writer facility that allows definition of reports based on data in the general ledger. This facility allows modification of profit/loss reports, balance sheets and budget comparisons. We found the general ledger to contain the standard features which are in most PC-based accounting packages.

Accounts Receivable Our reviewer highlighted the following features: balance forward and open-item accounting; statements may be printed and reprinted at any time to cover a range of dates; the ability to print invoices and statements on blank or letterhead stationery; the ability to dissect an invoice across a number of different general ledger income accounts; and audit ability for invoices.

Accounts Payable The IBS accounts payable module allows reports to be printed at any time to cover any range of dates. It also allows cheques and remittance advices to be printed; invoices dissected across a number of different general ledger expense accounts; disputed invoices to be held indefinitely until payment; and has an audit ability for all cheques.

Order Processing The IBS order processing module provides the following features: interfaces to the inventory, accounts receivable, personnel and general ledger systems; creates inventory stock movements for an order; creates an accounts receivable invoice for the order; creates a commission transaction if required for sales representatives; and accounts for stock on hand and cost of goods in the general ledger.

Inventory The IBS inventory module provides the following features:

- the number of possible stock items is limited only by the storage capacity;
- stock movements may be kept online for as long as required;
- stock items may be stored at an unlimited number of warehouses. IBS has the facility to transfer stock between different locations;
- stock may be purchased in units other than sales units; and
- stock count sheets which allow stocktakers to record stock levels. These sheets may be used as input documents to the stock taking program.

Finance Management The IBS finance management module provides the following features: handling of different types of loans such as mortgages, leases, bills of sale, hire purchase; provides a variety of different rebating and interest calculation methods; allows disbursement of funds from loan accounts to creditors on a client's behalf for payment of Stamp duty, insurance etc; produces projected liquidation reports to exhibit expected loan repayments over a specified period in the future; and accommodates additional charging to overdue accounts.

Conclusion

The standard 132-column printer used with the IBS accounting package is an Epson FX-100 or compatible. Control codes for other printers may be specified in the 'Printer Setup' option.

IBS is a multi-user, multi-company, fully

At a glance

Integrated Business Support
Supplier: Integrated Business Systems
Tel: (07) 366 6707
Price: $4995
Requires: 640k RAM, hard disk, MS-DOS 2.1 or later.
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integrated accounting package with multi-level report writer, standing journals, budgets and a comprehensive auditing facility. It is best suited to the small to medium finance company. The package is easy to use with an online help text facility throughout the system. The general presentation of IBS, however, does not reflect the power and flexibility of the package.

TAS+ Accounting

The TAS+ Accounting system was developed in the latter part of 1986 and was first released in March 1987. Like most software packages, it has been undergoing continual enhancement and modification since that time.

BTA is the Australian distributor of the TAS+ programming language, which is supplied by a firm in the US.

General impressions

TAS+ is a user friendly PC-based accounting package which offers an upgrade from single to multi-user and from a core system to a fully functioned, integrated package which can be modified by the user.

You have the option of initially purchasing the core modules of the package as a system called TAS+ Modifiable Accounting. This version contains general ledger, debtors and creditors modules. You may upgrade to the full version at any time by paying the difference between the prices.

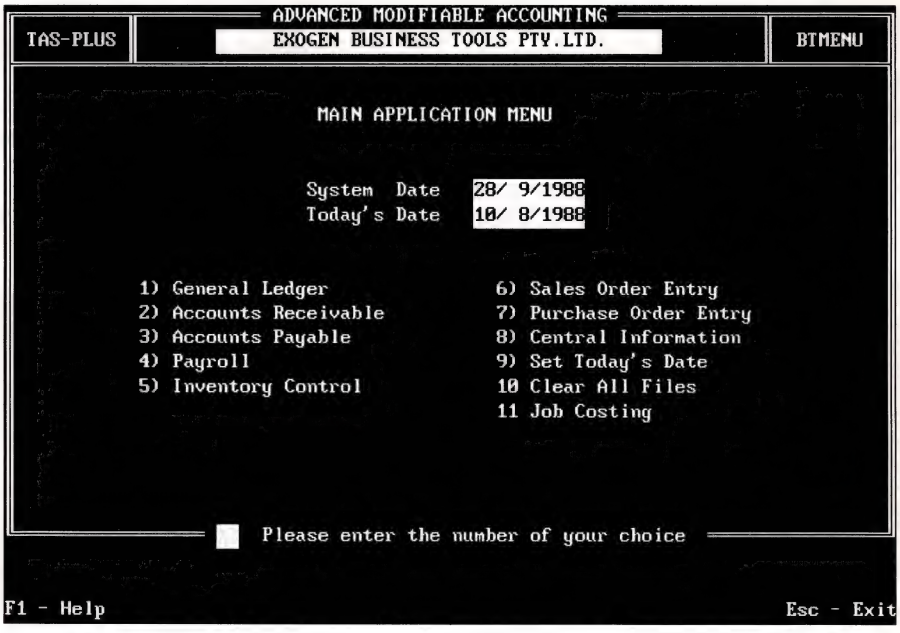
The complete system is called TAS+ Advanced Accounting which includes the three core modules plus Payroll, Inventory, Sales Order Entry, Purchase Order Entry, Job Costing and Bill of Materials Modules.

The first thing that stands out with this system is the menus. The initial menu is similar to Lotus 1-2-3. Unfortunately, this style does not continue through the lower levels of the menus, however the menus are clear and easy to find your way through.

The user manual is attractively packaged and appears to be quite thorough. The manual is clearly divided into each application system with an index of key words at the back of each section.

We found the speed of operation of the system to be satisfactory. Online help facilities are available. The help varies from being merely a list of available functions through to more detailed descriptions of what may be entered into a field. There are also cases where references are provided back to the user manual for further information.

Registered users receive a free quarterly newsletter called 'TAS News'. It contains many useful tips on accounting as well as the actual computer system.



The main menu for the TAS + Accounting package

The source code for the system is supplied with the package. This provides great flexibility through being able to modify the system to better suit your business needs.

A word of caution. Our past experience has shown that changes to programs require an expertise in programming which your business may not possess. The potential for introducing programming errors may not be worth the risk.

Registration and upgrades

You will need to be reasonably familiar with DOS to install this system. The instructions are quite detailed but rather long, and we feel that the novice computer user could make errors during the process.

The system came to us with eight diskettes, and quite a few pages of instructions to go with them. If you want the package to process transactions for multiple companies there are an extra four pages of installation instructions.

The first disk you install sets up the system's database on your computer. Initially, this database is restricted to a maximum 250 records. Similar to Effective Business Accounting, this allows you to use the system to decide whether it really suits your requirements.

The package comes with another diskette in a sealed package which will 'unlock' the database to allow full use of the system. If you return this disk still sealed in its package to the suppliers within 30 days you receive a full refund of the purchase price.

This may seem a better deal than EBA where you loose $99 if you decide you don't like the system. One advantage of EBA's approach is that there is no time limit for you to evaluate the package.

Hot-line support is provided by the vendor free of charge for the first 30 days after installation. This service may be extended for a fee of $250 per six months with a limit of 20 calls in that period. An additional support fee of $100 is required to cover the TAS+ database.

Updates and enhancements will be provided free if charge if this support arrangement is taken up. Otherwise, they are made available for a fee. The supplier told us that the latest upgrade cost $200 and that this was one of the higher upgrade prices. Onsite training is also available for a fee.

Capacity

The number of accounts in each of the ledgers is limited only by the capacity of the hard disk. One of the brochures indicated that the system could function on a dual floppy drive, but realistically the system programs including job costing and bill of materials requires 2Mbytes of storage. The system without these modules requires 1.4Mbytes of hard disk space. This is not excessive — packages with similar functionality require about the same storage.

Business Tools indicated to us that the

package comes with the modules set at certain parameters, which can be expanded/edited with the source code available from the supplier. We didn't reset any of the parameters, but Business Tools advised us that capable users have no problem modifying the parameters, and if help is required, Business Tools are happy to assist, with programming staff in Adelaide, Melbourne, Sydney, Brisbane, Canberra and Christchurch (in New Zealand).

Review of modules

General Ledger The TAS+ General Ledger Module was found to exhibit all the standard features one might expect to find, however it was a great deal more flexible than most.

Some of the more interesting features of this module were that the system could handle multiple profit centres, multiple departments or multiple companies on one system. In addition to keeping record of the current and budgeted figures, the system also kept amounts for two prior periods and operators could post and re-close prior periods at any time within the current year.

A non-destructive close facility lets you re-close a period as often as needed. Only the retained earning account was affected. The module reconciles cheque register to bank statement.

Accounts Receivable Some of the more versatile features of this module include: the operator is able to set up automatic recurring monthly charges to monthly accounts; interest can be charged on overdue invoices; it can produce a file in word processor format for producing 'personalised' form letters; and it can automatically create invoice transactions from the monthly transaction file.

Accounts Payable Invoices can be aged by vendor total or by all transactions, and may be selected for payment either manually or by date. The system can track vendor purchases, month-to-date and year-to-date totals. Recurring monthly charges are adequately handled and the system is also able to print a pro-forma cheque register to enable the user to determine whether the bank balance will cover the invoices selected for payment before cheques are printed.

Payroll Points of note found in the payroll module include: integration with other modules can be turned off for standalone operation; coinage analysis for each employee paid by cash with total for bank advice; income tax deductions automatically calculated with override facilities; prints pay cheques and group certificates; and the payroll may be rerun as required until posted.

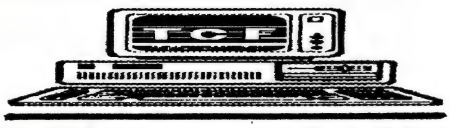
We found that the payroll module contained standard Australian payroll requirements. However, some customisation may be required where the user needs detailed payroll reporting in a multiple branch/department company.

Inventory Control This module is capable of keeping track of inventory levels, re-order points and outstanding purchase orders and backorders for each inventory item. It handles stock and non-stock items such as labour. Automatic calculations include quantity on hand, on reserve and available for sale. The system is also able to maintain separate inventories for multiple profit centres (sales and warehouse locations)

Sales Order Entry The sales order entry module was relatively sophisticated in its operation for its class. Points of note include:

- the module automatically looks up customer, shipping instructions, tax rates and credit terms. It also allows for manual override;
- automatic backorders are made when the amount to be shipped is less than the current level of inventory;

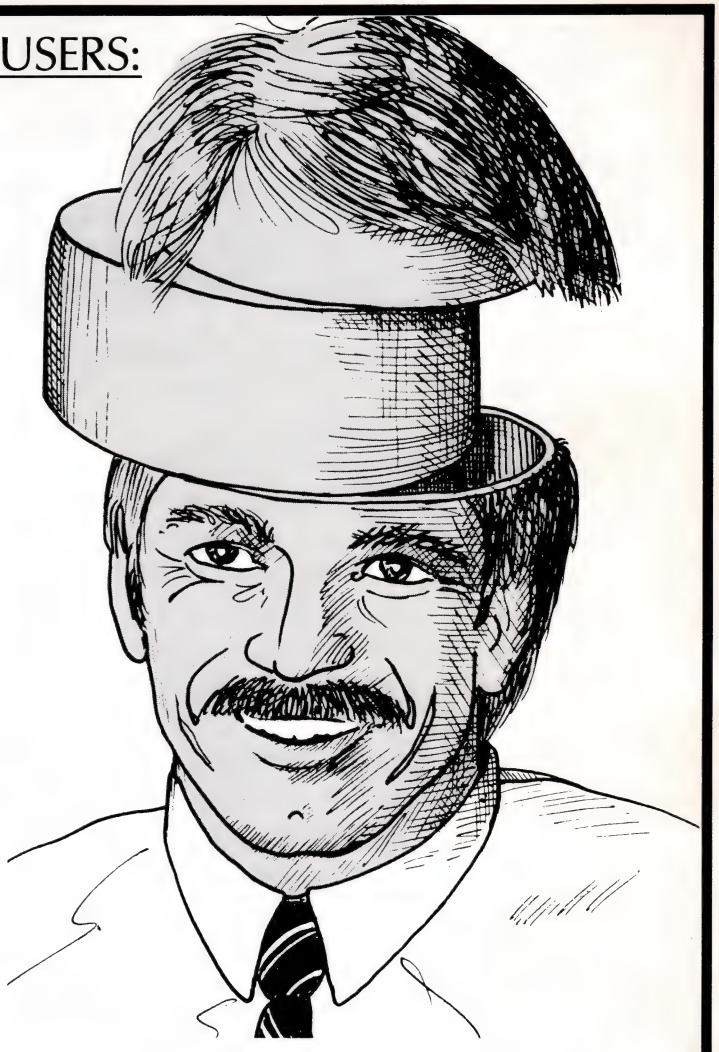
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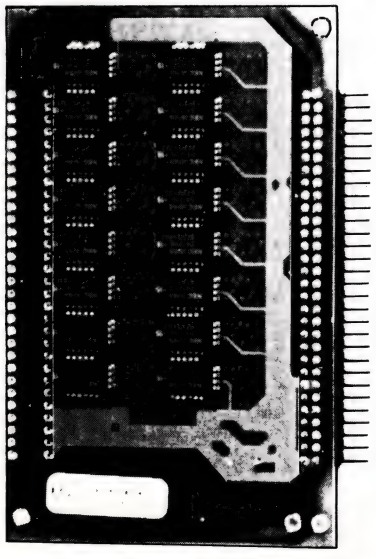
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- ability to handle partial shipments;
- prices on line items are calculated automatically, however, manual override is also possible;
- sales orders may be assigned to any profit centre location; and
- a track is kept on both expected and most recent shipping dates for each customer.

Purchase Order Entry Again, this module was quite versatile in its ability to cope with potential customer needs. The module automatically looks up vendor and credit terms and last cost, with manual override if necessary.

A track is kept for expected receive date and the most recent date an order was received from vendor. The module also allows for over/under shipment and change of price at time of receiving.

Bill of Materials This module was found to be reasonably flexible in its operation. Our review highlighted the following features: the use of explosion and implosion reports to indicate nature of compound and component items; the module can create up to nine levels of manufacture or assembly; and it interfaces with inventory control.

Job Costing The job costing module can be used with the modifiable or advanced version of TAS+. It has an interface with the general ledger, accounts receivable and accounts payable modules. Integration with inventory and payroll modules is available if required.

It was originally written to a specification for a builder's business, so is well suited to this industry. However, it has been further developed and is in fact being used in businesses such as building maintenance and air conditioning maintenance.

At a glance

TAS+ Accounting
Supplier: Business Tools Australia
Tel: (08) 211 7922
Price: Basic system (modifiable accounting) — $1410 single-user, $1752 multi-user; full system (advanced modifiable accounting) — $2000 single-user, $2342 multi-user; advanced accounting options — $300 bill of materials; $599 job costing.
Requires: 512k RAM, hard disk, PC/MS-DOS 2.1 or later.
In short: Modules available: Debtors, Creditors, Inventory, Sales Order Entry, Purchase Order Entry, Payroll, Job Costing, Bill of Materials and General Ledger.

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PC1009 PC DESK: Good program that allows you to keep a file of names and addresses and easily merge them into your documents using the inbuilt word processor. Also provides handy access to a calendar, calculator and phone dialler.

PC1022 TURBO SPELL: Spelling checking program that includes its own large dictionary and allows you to add your own words easily.

PC1037 READRITE: Memory resident style analyser that allows you to determine the readability using the Flesch scale, of text on your screen as you type it.

PC1080 THOUGHT ORGANISER: Thor, a brain scanning program. Allows you to outline your thoughts and ideas on any topic and review them, edit them, scan them, and print them as you need. Great for students and business people.

PC1220 ONBASE DATABASE: Excellent memory resident "pop-up" database which allows you to have up to three databases resident on your computer at all times.

PC1240 FILEMASTER: Program designed to help you manage your paper files. Allows you to maintain them in serial order and look them up by subject, category, sender, receiver, or a number of other criteria.

PC1400 LOTUS COMPATIBLE SPREADSHEET: AsEasy, an excellent Lotus 123 compatible spreadsheet program with almost all the features of its famous counterpart, and a host of power features.

PC1410 INSTACALC: Powerful memory resident "pop-up" spreadsheet which can read Lotus files. Can import data direct from screen and export data directly into word processing documents.

PC1623 PC BILL MASTER: Cheque book management program which is very easy to use. Has a regular cheque book register type display and maintains recurring payments. Allows for easy bank statement balancing, and up to 100 ledger accounts.

PC1681 SOLVE-IT: Financial analysis program which calculates return on investment, break even analysis, depreciation schedules, loan schedules and even statistics. Computes 28 functions in all.

PC1750 SPC INVENTORY: Good inventory program which keeps track of sales, stock, and replacement cost. Can add sales tax, and handles up to three selling prices per item.

PC1860 MANAGEMENT TUTOR: Collection of programs that provide a complete computerised management course. Covers communication, delegation, decision making, interviewing, and planning.

PC1962 EASY PROJECT: Project management tool which allows upto 20 user defined project phases, unlimited number of resources per project, up to 1000 user defined tasks per project, fast data entry, automatic scheduling, and Gantt chart production.

PC3101 OVERVIEW: DOS shell file manager for hard disk users. Enables you to carry out routine file commands easily as well as providing a tree directory of your drive, multiple window access to up to six directories, file view function, and more.

PC3230 CP/M TRANSFER: Excellent CP/M to DOS transfer utility that also includes a CP/M emulator. Allows you to read Osborne, Kaypro, Morrow, and other CP/M formats, and even run the CP/M programs on your PC. **TWO DISK SET.**

PC3270 SOFT-TOUCH: Keyboard utility that allows you to program individual key combinations with user defined keystrokes or macros. Also allows you to combine three keystrokes into even larger macros.

PC3400 LQ: Memory resident printer utility that allows you to produce letter quality print on inexpensive dot matrix printers. Also lets you use different font sets on your printer with four fonts available at all times. Suitable for Epson, Star, Citoh, and IBM Proprinter.

PC3450 CLASER: Excellent utility for HP Laserjet users. Allows easy choice of printer fonts, printer port, graphic screen dumps, and even allows Laserjet to emulate an Epson FX printer.

PC3500 P-BASIC: BASICA compatible basic interpreter. Runs almost all Basic software. Suitable for Amstra PCs to replace non compatible BASIC-2.

PC5030 OPTIKS: Astounding graphics package which allows you to read and write almost any graphics format including MacPaint, PCPaintbrush, Newsroom, MS Paint, and more. Supports most printers including HP Lasejet, and even supports scanners. Most powerful graphics package we have seen. **TWO DISK SET.**

PC5750 BARCODE GENERATOR: Create barcodes with this program and your printer. Uses 3 of 9 system which allows for full alphanumeric coding. Configured for Epson and IBM Proprinter, but can be configured for other printers.

RECREATION

PC2030 3D CHESS: Excellent graphics chess game suitable for both CGA and Hercules video. Multiple levels of play from beginner to champion. Allows analysis of play, help as you play, and a true three dimensional view of the screen.

PC2042 DIAMOND BASEBALL: Text simulation of the play by play action of a baseball game. You are presented with all the situations faced by a major league manager. So good it was used by a US radio station to simulate a game cancelled due to a strike.

PC2060 AMERICAS CUP YACHT RACE: Excellent graphics game which allows you to race the cup from your PC. Control the rudder and the sails as you tack and round the buoys with the best. This game has to be seen to be believed.

PC2052 REFLEX POINT: Graphics game where you have to save the Earth from Invids. In order to complete your mission you will use motor cycles that become body armour and jets that become robots.

PC2054 NINJA: Martial arts game which combines platforms with arcade action fighting. Requires CGA video card.

PC2100 SLEUTH: Adventure game where you have to find the murderer. Each time you play a new scenario is produced so you never get bored.

PC2106 SPACE QUEST: Adventure game with graphics where you are travelling through space and as you near your destination, trouble strikes.

PC2110 BRAINSCAPE: Excellent educational adventure game which teaches you neuroanatomy as you play. You find yourself alone in the brain fighting to find your way out. Interesting graphics.

PC2202 BLACK JACK TUTOR: Blackjack game which actually helps you improve your game. You play against the computer which helps you practice new tactics and strategy as you play.

PC2300 WAR ON THE SEA: High level strategic and tactical simulation of typical World War II naval campaigns.

PC2353 MEGAGOPOLY: Great investment strategy game . You inherit $100,000 and must obtain financial independence. Test your investment skills whilst having fun.

PC2800 ASTROTIT: Adult arcade game. Destroy the falling objects before they destroy you. However you have to see them to believe them. Great fun for adults.

PC2806 FRENCH: Adult adventure game based in a French whorehouse. Find your way out but make sure you "look" at all the girls first.

PC8005 ABC : Good program for children to learn letters and numbers, and also develop their computer literacy.

PC8020 CALCULUS TUTOR: Good program for those ready to learn Calculus and advanced mathematics. Covers trigonometry, algebra, exponents and more.

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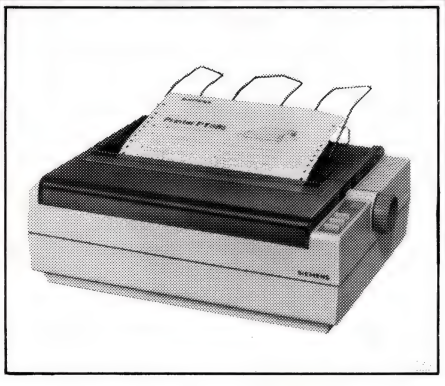
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Conclusion

The system works with any 80- or 132-column ASCII printer compatible with the hardware and software configuration of the PC. Some accounting reports do require printouts 132 columns wide, so a wide-carriage printer of this type is recommended.

TAS+ is a comprehensive accounting package. Its suppliers provide a good level of support and are constantly adding to and improving the product.

The system is flexible and provides a good coverage of the features required by a small to medium organisation. Pricing is consistent with a package of this size and features.

Chief

Chief was fully developed in Australia by Ideal Systems to provide an accounting solution for small businesses and service-oriented companies. Ideal Systems — a young Australian software company currently located in Melbourne — designed the package with dBASE-compatible data files, enabling users familiar with dBASE to easily extract data to produce more detailed reports.

General impressions

Many software packages currently available try to support a complete company/personal finance and general ledger system. However, they achieve this with varying degrees of success. With Chief, it was refreshing to find a package that was simple to use and actually did what it was supposed to do — accounts receivable and customer trading.

Chief is a customer tracking and accounts receivable package and, as such, does not rank with the more sophisticated accounting packages. However, as its manual states, it is aimed at the businessman 'who wants the fundamentals, without wasting valuable time learning a complicated package that he/she will never fully use'. To this end, we think it achieves its goal remarkably well.

The system is menu-operated and includes a comprehensive help facility that makes it easy to use, even for novice users. But Chief's strong point is that it simplifies the paperwork associated with invoicing customers and producing statements, without regimenting the user's accounting procedures.

We tested Chief version 1.3, which included a number of enhancements over the original version 1.1. Some of its more appealing features include: a browse facility, which allows the user to view past invoices for each account; account ageing by 30, 60 or 90 days for each customer permanently displayed on the screen; improved reporting, including running totals in printed reports; and improved speed, performance and error handling.

Other features adding a little more versatility to the product include: an account filter option, which may be used to select only the accounts which meet a specified criteria; sequential invoice numbering; full integration of a bank and customer account balance with invoices, payments received, and withdrawals; a complete bank and client statement printing facility; and facilities enabling the user to alter monitor shading/colours, data filenames, and so on.

The system also comes complete with a comprehensive manual, and to ensure correct usage, several short tutorial exercises have been included.

Registration and upgrades

Chief can be purchased direct from Ideal



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Systems or from any participating vendor. After completing and mailing a warranty registration form, the product remains under warranty for one year from the date of purchase. However, the warranty limits the liability of Ideal Systems to the supply of one service, or payment of the cost of having the service supplied again.

Chief was written as a general use software application, however, industry specific modifications will be made by Ideal Systems on a contract basis to fulfill a client's particular requirements.

Review of modules

The accounts receivable module is the primary component of the Chief system. Its operation remains uncomplicated and easy to use to all level of operators. After invoking the main menu option for entering or editing data, the operator is taken straight to the main data screen. This screen contains the necessary information for any one particular client or bank, and includes such fields as: account name/number, contact; company, address, type (such as customer, dealer, bank), phone number, contact dates, and notes.

The top right corner of the screen permanently displays a list of Chief's function keys and their purpose. When one of these is selected the associated input screen appears over the primary data screen — much the same as papers might appear on a desktop.

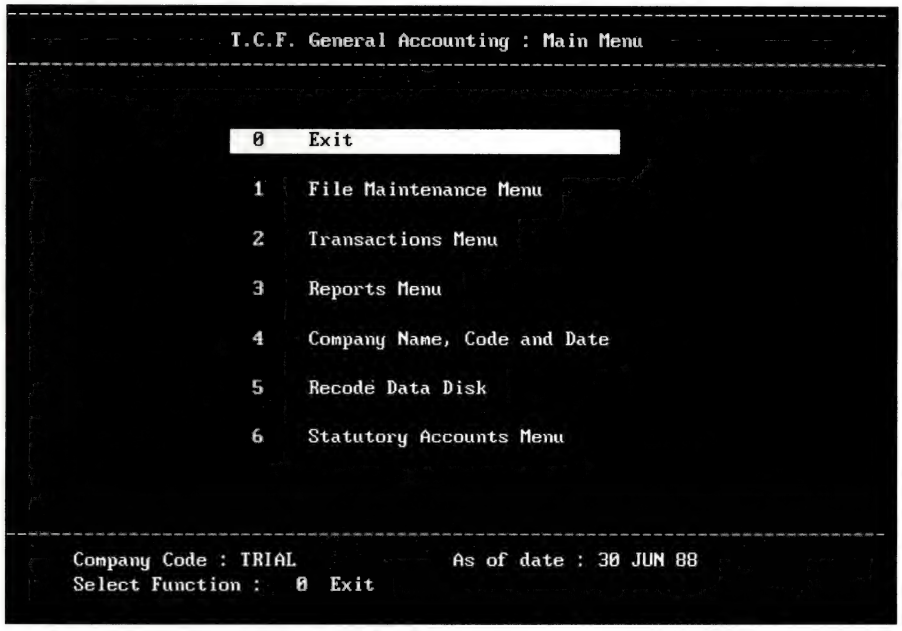
A strong feature built into Chief is that upon entry of invoice, withdrawal and payment received data, all relevant and related data fields — such as the bank balance or debtor balance — are updated. This safeguards against the 'forget to save' moments and the inevitable loss of data.

Because of the ease of data input and data editing, the only perceived drawback with the system is its lack of security. Ideally, the operator must restrict access to the actual computer, because, once inside, there is no provision to restrict anyone from tampering with sensitive data.

A significant drawback is that the system does not maintain an audit trail of individual transactions because it updates transactions to a single account balance on an automatic basis.

At a glance

Chief, version 1.3
Supplier: Ideal Systems
Tel: (03) 663 6276
Price: $299 (approx)
Requires: 370k RAM, two 5.25in disk drives or hard disk, DOS 2.1 or later.
In short: A menu-operated customer tracking and accounts receivable package designed to provide an accounting solution for small businesses and service-oriented companies. Includes a comprehensive help facility, which makes it easy to use, even for novice users.



The main menu of TCF General Accounting displayed when the package is loaded

Conclusion

The Chief customer tracking and accounts receivable package is designed to print to any IBM XT or AT-compatible printer. Ideal Systems has developed its own standard invoice form for use with Chief. This can be used on most tractor feed, dot-matrix-type printers able to accommodate 80-column perforated paper. The format however, can be adapted to suit individual user requirements.

At around $299, Chief is a value-for-money, easy-to-use accounts receivable and customer tracking package. It is targetted at the first-time computer user wishing to introduce computers into a manual system, as well as those in the service industry who do not need to keep details of stock levels or ordering systems. We were not able to find any major flaws with the system other than its lack of an audit trail.

TCF General Accounting

TCF General Accounting (Accountants' Version) was developed by Computer Factory to keep a variety of accounting records for small and medium-sized businesses producing valuable interim financial reports. Subsequently, users are able to produce directly from the records, the formal end-of-year accounts, statutory reports of directors and of the company accountants or auditors, and minutes of required meetings of directors and shareholders.

General impressions

TCF is an accounting package aimed at small to medium-sized businesses. The package operates on what it calls an 'individual and conventional books of account' basis, however, while the concept seems relatively sound, the theory, put into practice, seems somewhat less stable.

When using the package for the first few times, the system seemed a little hostile; on examination, we found that the system lacked some of the standard features found in other packages. For instance, the availability of a help system, while not essential for basic understanding, would greatly improve user confidence in some instances. It may also reduce the time-consuming 'manual reference routine' which the system design ensures must happen.

The package also appeared to contain some disconcerting bugs. For example, at a couple of points when errors occurred within the program, execution would unexpectedly terminate and we would be returned to the DOS prompt. Also, when deleting or inserting debtors,

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employees, and so on, the system would sometimes duplicate records already held in the data file.

In addition, we also found several features which might be annoying in everyday use. On entering general journals, the system permitted one-sided (or unbalanced) entries to be made — although in all fairness, a warning was sounded before exiting. Currency amounts greater than $999,999 also became hard to read because the package converted the balance to scientific notation. A further annoying idiosyncrasy was that for every amount, the cents had to be entered — even if the amount was a round dollar figure.

TCF has incorporated a curious queuing system for processing transactions for cash payments, cash receipts and general journals. The appropriate options are selected from the menu and placed in a queue; users are then required to execute the queue in order to process transactions. This became a tedious process when a variety of different transactions were to be processed in succession.

Registration and upgrades

The purchaser of TCF General Accounting is required to register the purchase with the TCF Computer Systems, and must use a registration number, along with the company name when installing the system.

The TCF General Accounting package can be upgraded to the Accountants' version by including a statutory accounting module. At the time of testing, we were informed that this module is currently being modified for the Schedule 7 Companies Code changes made in July 1987.

Review of modules

General Ledger The key features of the general ledger module are: a conventional-type journal allowing descriptive text to be attached to each entry; and an 'Out of Balance' warning for each entry.

Accounts Receivable The key features of the accounts receivable module are: a conventional-type cash receipts book; integration with general and debtors ledgers; a batch control function; and automatic income analysis with each printout.

In addition, debtors ledger records debit transactions and provide lists of outstanding debtors, maintaining balance with the general ledger control accounts. Lists are aged only as between balances brought forward and current period. Statements are not produced.

Individual entries are shown in the debtors ledger, whereas entries to the general ledger are posted in summary form for each of the books of account. (However, 'Enquire General Ledger' will automatically detail individual entries to any chosen account.

Key features to the sales journals include: automatic invoice numbering; a batch control function; and an automatic income analysis with each printout. Numbers allocated to each customer also recall general ledger income type to assist rapid entry and avoid operator error, and cash sales can bypass debtors ledger to be recorded directly into general ledger.

Accounts Payable The key features of the accounts payable module include: a batch control function; automatic expense analysis with each printout; and automatic invoice numbering.

In addition, numbers allocated to each supplier also recall general ledger expenses to assist rapid entry and avoid operator error. Creditors ledger records also credit transactions and provide lists of outstanding creditors, maintaining balance with the general ledger control accounts. Cheque requisitions are not generated.

Individual entries are shown in the debtors ledger, whereas entries to the general ledger are posted in summary form for each of the books of account. (However, 'Enquire General Ledger' will automatically detail individual entries to any chosen account.)

Cash Payments Main features include: access to creditors, debtors and payroll ledgers as well as the general ledger; automatic cheque numbering; the ability to split cheques eleven ways; a batch control function; the ability to code payees by name as well as expense type, allowing rapid entry of cheque details; and automatic expense analysis with each printout.

Statutory Accounting This module is currently being updated to reflect the changes made in Schedule 7 of the Companies Code. At the time of review, we were unable to find out when this module will be ready for release.

At a glance

TCF General Accounting
Supplier: TCF Computer Systems
Tel: (02) 938 2522
Price: $795
Requires: 128k RAM, 5.25in 360k floppy, PC/MS-DOS or CP/M.
In short: An accounting package aimed at small to medium-sized businesses, but hampered by several programming bugs. Modules included: General Ledger, Accounts Receivable, Accounts Payable and Statutory Accounting.

Conclusion

The system requires either an 80- or 132-column printer. A dot-matrix printer is sufficient and the system has no unusual requirements regarding special stationery for forms such as invoices or statements.

The TCF General Accounting package has been designed on the 'individual and conventional books of account' basis. This has been described as an ideal package for those learning the basics of bookkeeping. The idea seems sound and may have a strong potential within the business sector. However, the package tested contained several programming bugs which would need to be rectified before one might seriously consider implementing the package. The current system is also hampered by the old statutory accounting module, however, once upgraded, the system may become more relevant to today's business demands.

Attache4

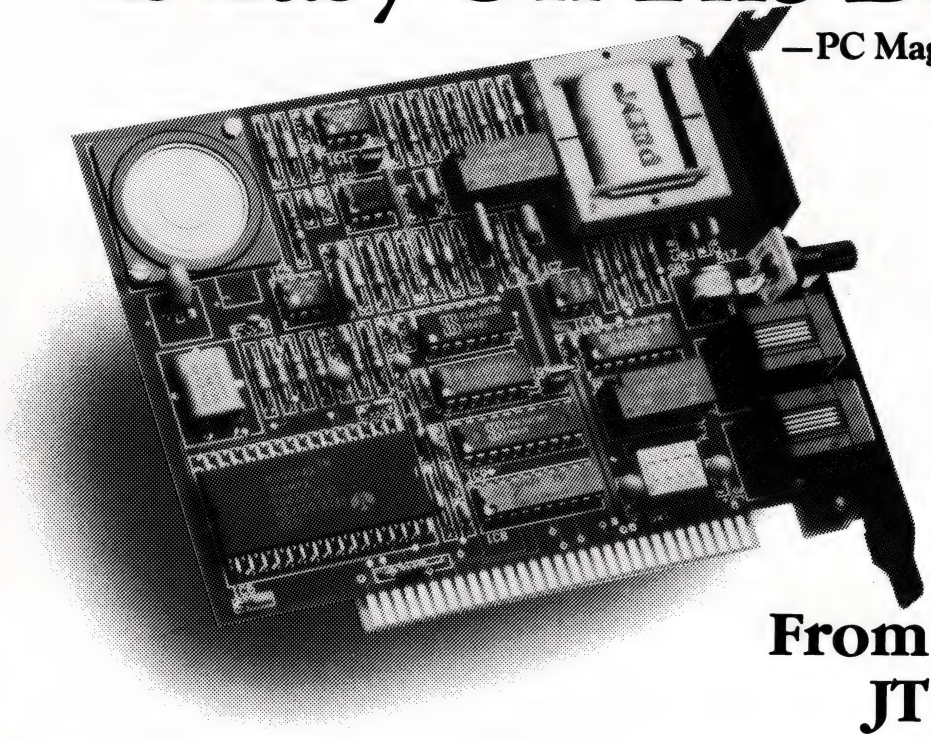
Attache Software Australia, based in North Sydney, is recognised as having the largest base of users of single-user packages with 20 per cent of the Australian market. The company distributes the Attache4 package and its big brother, Attache.

General impressions

Attache4 is a single-user low-end accounting package written for the price conscious small business buyer. Even the names of the modules — customers, products, suppliers, and general ledger — were chosen for the non-accountant. Attache4 is written in Basic , and arrives in a shrink-wrapped binder complete with manual and a single program disk which contains the four operating modules. Potential buyers who only have single-user requirements for the four functional areas included in Attache4 should seriously consider at least calling Attache Software or an Attache Dealer for a free demonstration diskette — which is actually a restricted version of the live product. The Help function is adequate and the manual gives adequate treatment to an overview of and

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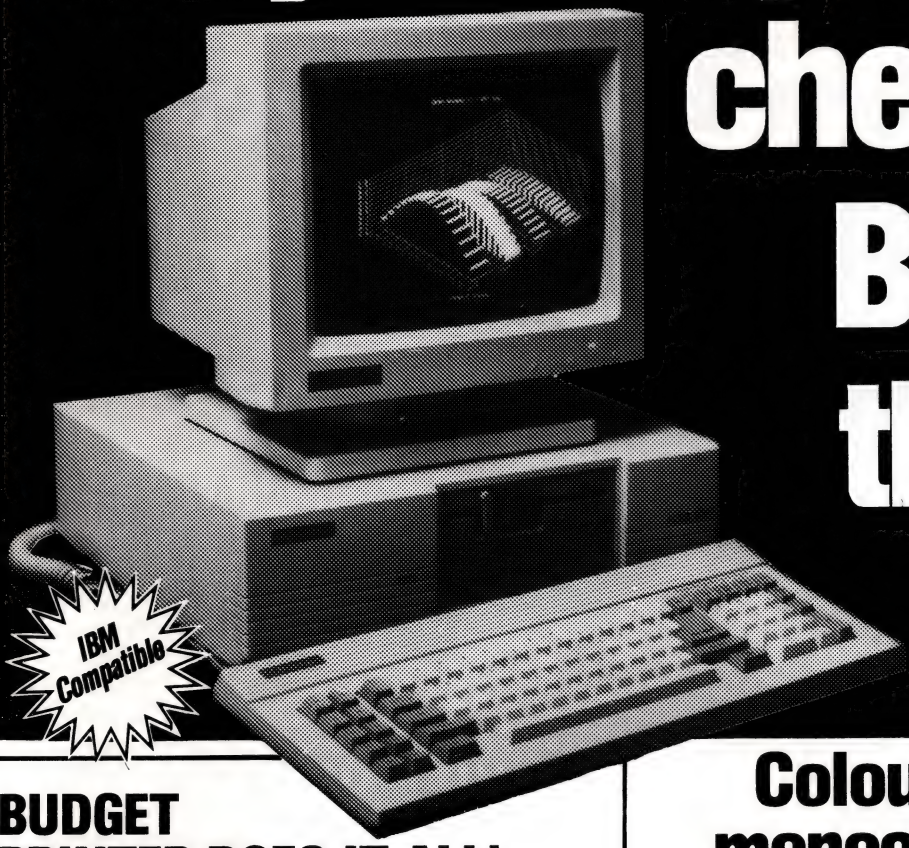
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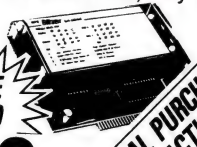
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installation and use of the package, as well as a short accounting terms primer. We feel that the error messages appendix could be a little more helpful than 'You should not get this error' and 'Seek professional advice,' — especially given that the preface stresses that there is no free support included in the price.

Registration and upgrades

To register the software after purchase, the Attache4 user rings Attache Software and is quoted a unique registration number, which is keyed in to the package to unlock the modules. Have the company name you wish to appear on invoices, statements, and reports ready for quoting to the company before you call.

There is no annual maintenance fee and there have been no upgrades since May 1987, when Attache4 was launched. A spokesperson for Attache Software told us that upgrades would only be necessary where changes in legislation required programming changes in the package.

The Attache4 buyer can upgrade his software to its big brother (Attache), if Attache4 doesn't meet his/her needs. Users wanting to upgrade from Attache4 to the 'Attache Business Pack 4' (six modules) within six months of purchase, are eligible for a 100 per cent trade-in allowance on the cost of Attache4, and a 50 per cent trade-in if upgrading to any three to five modules of Attache.

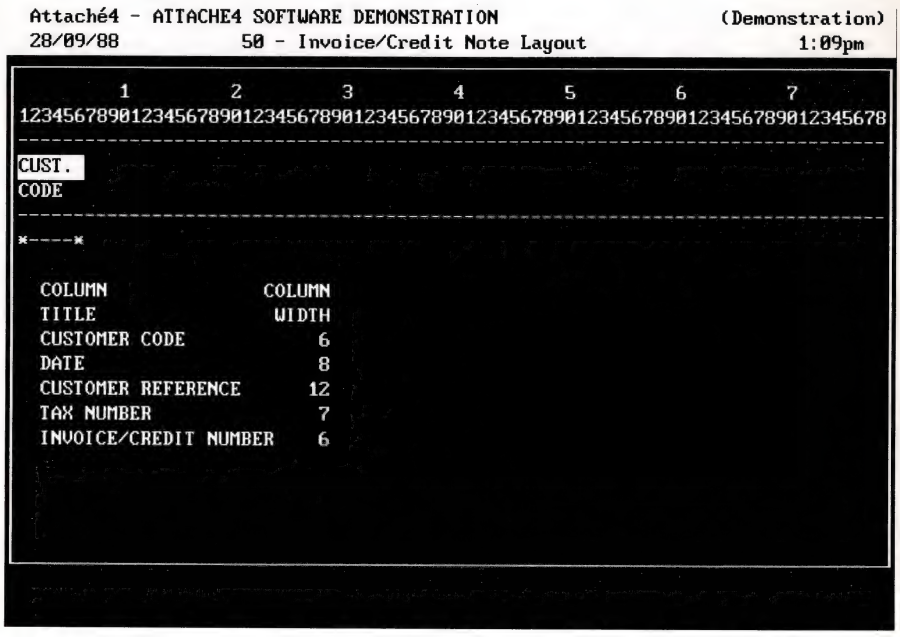
Review of modules

General Ledger The general ledger modules is basic, but provides enough features for the requirements of a small business. In addition, it's flexible, and is reasonably sound and easy to use. The general ledger can be integrated with the other three modules for automatic posting or can be run by itself. This facility can be easily set by the user.

Attache4 comes with a basic Chart of Accounts which can be used as is, or changed to suit the business. There are 12 reporting periods which can be named by the user — these are essential features of any accounting package.

We were unable to test month-end processing because the demonstration disk supplied by Attache Software did not allow this to be performed.

The general ledger module doesn't appear to handle standing journals or prior year adjustments. These are not generally expected features in a system of this size, and many businesses can operate without them, but if you must have them and you buy Attache4, you will need to improvise with manual workarounds.



The Attache4 invoice layout designing module

Customers The customers module is a simple cut-down of a debtors ledger which has retained enough of the essential functions required for a small business to control debtors effectively.

The module has a good enquiry facility, and new customers can be set up when posting. There is a good debtors aged trial balance report, which includes customer telephone and contact details next to the total balance and the amount and date of the last payment received — just the thing for following up slow payers.

The customers module is linked with the other modules so that users are able to raise an invoice by keying in a product code and quantity. The remainder of the invoice is created automatically, including product description, stock reduction on the products module, posting to the customers account, sales tax reporting and sales analysis. Prices, sales tax and discounts can be changed on the invoice itself, and the invoices can have comments and sales of non-stock items.

Many of these features are available on the majority of accounting packages and are standard kit for what is essentially, a simple debtors system. The inclusion of these features in Attache4 simply indicates that the developers understand the basics that are required to run the majority of small businesses, and have stripped away the frills to create a no-nonsense single-user package.

Suppliers Like the customers module, the suppliers module is basically a cut-down creditors ledger, which nevertheless, provides enough functionality to help a small business proprietor control his outwards cash-flow better than if he were keeping tabs on his suppliers with a manual system.

The suppliers module accepts the standard creditor details like almost all creditors ledgers; including name, address, contact, telephone, comments, and details of invoices owed and payments made. This module is almost a mirror of the customers module, with similarly formatted reports.

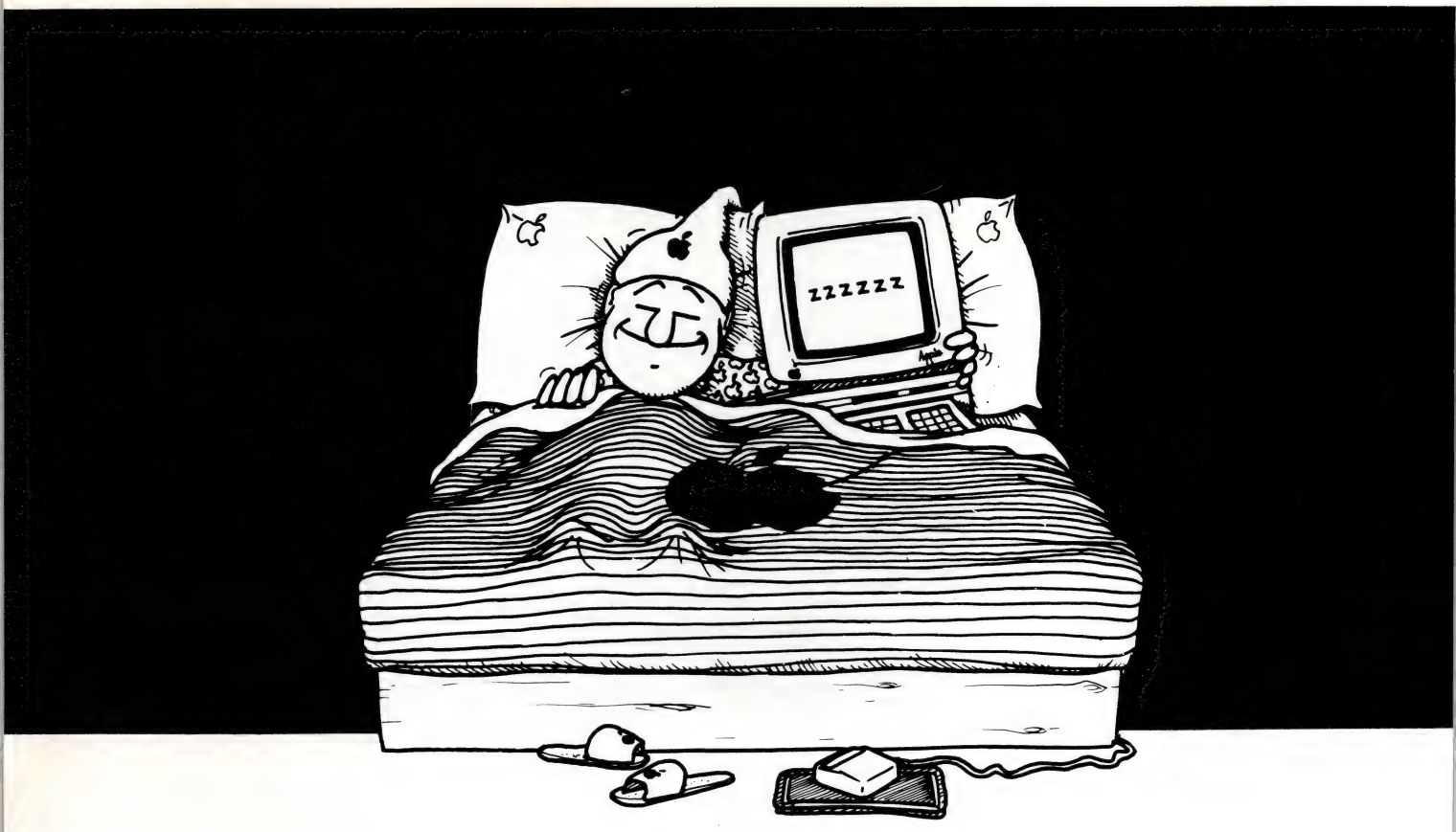
There are no bells and whistles here either, but these should not be expected for its competitive price.

Products The products module is essentially a basic inventory system, which can be integrated with the customer module for sales of stock items.

Stock items can have up to 12 characters in their product code and a 25-character product description. We found the setup of products in this module to be an easy process.

There are no stocktaking report or automatic product price maintenance facilities. When an accounting package is able to perform automatic product price maintenance, the value of the stock item held in the inventory module is automatically updated by the price at which new stocks are purchased. This is normally achieved through integration between the stock control, accounts payable and purchase order modules of many accounting systems.

Again, we point out that you cannot expect to have everything in a budget priced accounting package, and At-



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At a glance

Attache4
Supplier: Attache Software Australia
Tel: (02) 929 8700
Price: $999
Requires: 256k RAM, two disk drives or hard disk, DOS 2.1 or later.
In short: A low-end accounting package aimed at price-conscious users who are prepared to 'fit' their accounting procedures to the functionality of the package. Modules available: General Ledger, Customers, Suppliers and Products.

tache4 does have the basics that are necessary to drive a business that either sells products or services.

Conclusion

Attache4 uses plain 132-column continuous paper for reports. Invoices and statements can be printed on plain paper, but are more presentable on pre-printed stationery, which is available from Attache Software, some Attache dealers and Moore Paragon Australia.

Attache4 has a reasonable pedigree and an upgrade path to a more fully-featured product for users who find that its functionality is not as wide as their needs. The potential buyer must accept that there is indeed a trade-off between price and power in a package, and that Attache4 is aimed at price-conscious users who are prepared to 'fit' their accounting procedures to the functionality of the package. However, Attache4 is used by a wide range of businesses, including video shops, a well-known sailmaker, jewellers, electrical contractors, restaurants, a bookbinding company and a battery importer, so the odds are that it may fit with your business.

Tips and traps for potential users

One of the most common traps for buyers of accounting packages is purchasing a system that is too small for the volume of transactions that flow through the business. If your manual accounting system requires two or more debtors clerks to maintain it, then a small single-user debtors system may be unable to cope with the workload.

There are many accounting packages that will run on a multi-user basis as well as on a single PC, and a purchaser should not be looking at single-user packages if there is a likelihood that his business will outgrow them in the foreseeable future. Making sure that the system you will use to maintain your accounts is capable of handling your transaction volumes is called sizing the package and the hardware.

You should ask potential vendors to provide you with information about the memory required to run the programs, and the storage that will be necessary to file a year's worth of processing, based on your current transaction volumes. Your transaction volumes include the number of sales orders, sales invoices, debtors, purchase orders, invoices, statements, cheques, employees and pay periods that your manual system currently handles.

When you have gathered this information, you will need to factor up the numbers for expected growth in the business for at least two years. A useful tip is to plot transaction volumes over the last two years before predicting future growth.

Another common trap is to attempt to implement a computerised accounting system where there are a lack of existing manual accounting procedures, and where the intention is to remedy the problem by automating.

'The most important issue in selecting an accounting software package is the fit between the package and your business needs.'

If deficiencies in your manual accounting procedures are prompting you to computerise, you could be replacing an accounting problem with a computing problem and an accounting problem. A tip is to straighten out your manual procedures first, or if this is not possible, seek help from an expert.

A third trap is to base your purchase decision solely on the representations of the software vendor. Many vendors are willing to assess the suitability of their software for your business, but there is risk involved in relying on their judgement.

The most important issue in selecting an accounting software package is the fit between the package and your business needs. You should spend time analysing the features your system 'must have' and the features that would be 'nice to have' before trying to absorb the inevitable deluge of information that will accompany your foray into the world of accounting package vendors. Critically assess the information that you are receiving against your list of requirements and don't accept a package that doesn't, as a minimum, meet your 'must haves'.

Consulting firms can often reduce the selection process through their knowledge of available packages, and using a consultant is often a cost-effective way to select and implement a system with minimum disruption to your business.

Conclusion

The general accounting software packages on the market are suitable for a wide range of applications. Most include set-up options that allow the user to tailor the package to specific requirements. Remember, accounting systems require training to use, but once they are applied, can make you more productive — if you've chosen the right program.

END

Review team

The Touche Ross review team

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Phillip Wing is a partner with Touche Ross and is the Director of Advanced Technology Services (ATS) in New South Wales.

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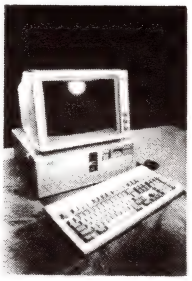
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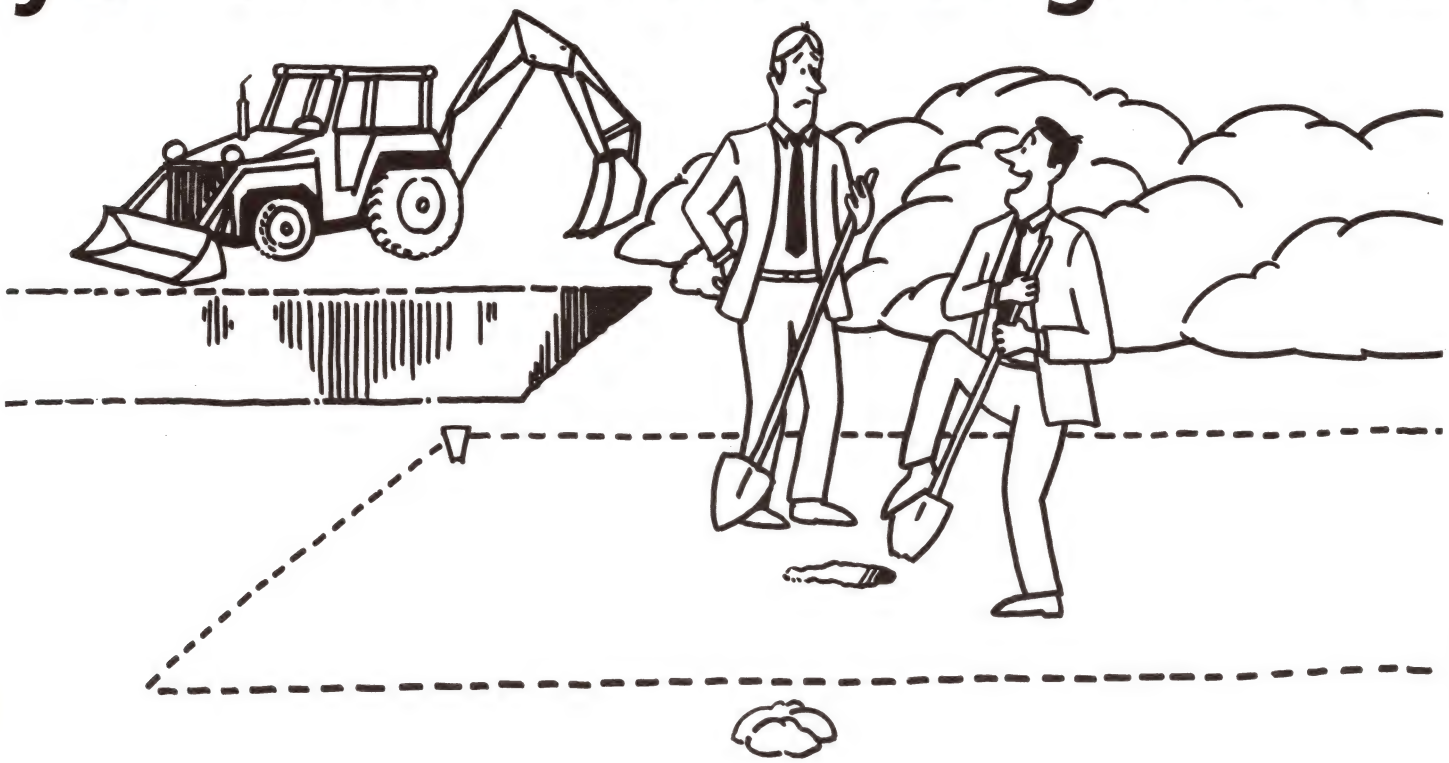
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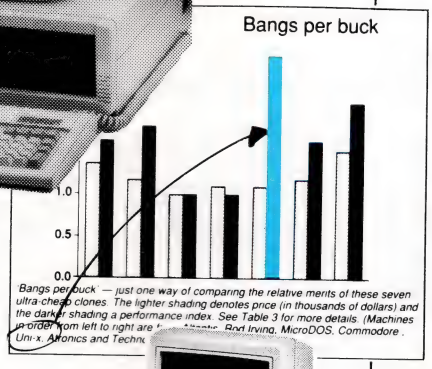
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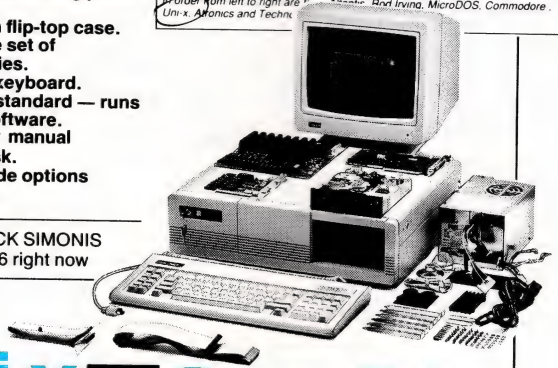
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Bangs per buck — just one way of comparing the relative merits of these seven ultra-cheap clones. The lighter shading denotes price (in thousands of dollars) and the darker shading a performance index. See Table 3 for more details. (Machines ... from left to right are ... Bert Irving, MicroDOS, Commodore, Uni-x, Amonics and Techno



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NEC. The Uni-x contains a NEC V20, manufactured by Sony.

Thus a V20 running at 4.77MHz will outrun an 8088 running at the same clock speed.

machines examined provided a standard PC clock rate of 4.77MHz as a minimum, although the Uni-x delivered higher than standard performance even on this clock rate by virtue of the V20. The Atlantis and machines

Performance.

The Uni-x is fastest overall, providing a 50 per cent boost over the Technology Interface due to the V20.

interesting of all, there is al

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Specifics.

The Uni-x features a delightfully small motherboard. It has employed a VLSI component to replace the Intel 8253 timer, 8255 PPI, 8237 DMA controller and several other components. This reduced the component count and a simplified motherboard serves to reduce costs.

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Speed up hard disks with DCACHE

While IBM has a disk-caching program for PS/2 models, it doesn't have one for PCs. Douglas Boling finds a utility PC owners can use to make hard disks seem to run up to 50 per cent faster.

The unending quest for greater computer speed began when the first man greased the rails of an abacus. Whether in listing a directory, loading a program or recalculating a spreadsheet, perceived speed is perceived power. The best way to increase your computer's speed, however, is not necessarily to rush out and buy the latest accelerator board or a faster crystal. Like most PC operations, the first two of the three examples above involve the disk drive. Disk operations, not a difference in microprocessor or clock rate, are what made the IBM PC-XT so much faster than the PC.

The speed difference between the PS/2 Models 50 and 60 provides a more recent and instructive example. Both run at the same 10MHz, one-wait-state speed, but users initially criticised the slowness of the Model 50. IBM provided a solution in the form of a program called IBMCACHE.COM, which comes with the reference diskette for the Model 50/60. This excellent program speeds up the Model 50 to the point where it nearly matches the Model 60. (If you use a Model 50, 60 or 80 and you haven't discovered IBMCACHE.COM, be sure to read the box 'Hidden gold in the PS/2'.)

If you haven't purchased a PS/2, however, the DCACHE.COM utility presented here is the way to go. A terminate-and-stay-resident program, DCACHE is a hard disk cache that speeds up your computer by cutting the disk access time by as much as 50 per cent. It reduces response time by keeping the most recently used data from the disk in its own reserved section of RAM. Then, when the hard disk is asked for data, DCACHE looks to see if the requested data is already being held in RAM. If so, DCACHE returns the data to DOS without having to waste time accessing the disk.

DCACHE.COM is available for downloading from Microtex *6663# on Telecom's Viatel; or by sending a blank formatted 5.25in disk with a stamped, self-addressed package to Jean Lowers, *APC*, 124 Castlereagh Street, Sydney 2000. Both the assembly language listing (DCACHE.ASM) and an alternative Basic program (DCACHE.BAS), which will automatically create DCACHE.COM when run once, are presented here.

Using DCACHE

You can install and activate the DCACHE program simply by entering the command below either at the DOS prompt or as a line in your AUTOEXEC.BAT file. Its full syntax, including optional parameters, is

```
DCACHE [/OFF | /ON] [/U]
[/Mx] [/E] [/Hx]
```

The DCACHE default parameters upon loading activate a cache of 64k in size, located in low memory, and cache the primary hard disk. DCACHE can be customised for any machine by using command-line parameters. The size of the area of RAM reserved by DCACHE can be adjusted from 16k to 8Mbytes by including the /Mx parameter, where x is the size (in kilobytes) desired. Allowable values for x are 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, and 8192. To specify a 256k cache the command would be DCACHE /M256. DCACHE uses about 1200 bytes in addition to the amount of memory specified for the cache.

DCACHE provides the option of using memory that conforms to the Lotus/Intel/Microsoft expanded memory specification. In fact, to use caches larger than 256k, the use of expanded memory is required. To specify expanded rather than conventional memory, simply include the /E parameter when you execute DCACHE.

AT-compatible computers usually allow two hard disks to be attached to the disk controller. DCACHE allows you to specify the disk you wish to cache. If you wish DCACHE to cache the secondary disk, put the /H1 parameter on the command line. (The default, the primary disk, is /H0.) It is important to note that DCACHE caches the physical disk, not

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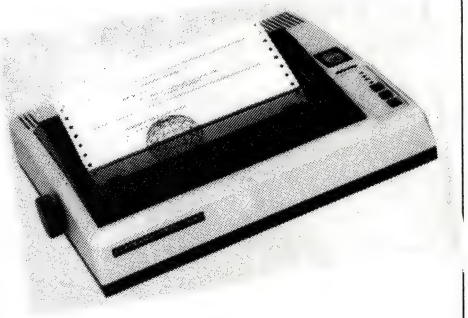
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the logical DOS partition of a disk. DCACHE treats a partitioned disk as one disk.

DCACHE allows itself to be removed from memory. If you are using DCACHE in conventional memory and you see that dreaded message 'Program too large for memory', you can simply enter the command DCACHE /U to uninstall DCACHE and free the memory it was using. The limitation here is that for /U to work, DCACHE must be the last TSR program installed. Additionally, the BIOS disk interrupt (13h) must not have been altered since DCACHE was installed. If the interrupt has been changed, DCACHE prints an error message indicating that the cache cannot be removed.

Without uninstalling it, DCACHE can be disabled and enabled on command. To disable DCACHE, you simply enter DCACHE /OFF. Once the cache is disabled, all disk accesses will be passed directly to BIOS, without caching. To enable the cache again, enter DCACHE /ON. When DCACHE is installed, the cache is automatically enabled. To install the cache and immediately disable it, include /OFF with the other installation commands. ON, OFF and Uninstall are the only DCACHE commands allowed after the cache has been installed.

If you forget the command-line switches and don't have this article around, typing DCACHE ? will present a short list of the allowable commands without installing the cache. If DCACHE has already been installed, only the /ON, /OFF and /U commands will be listed. If you try to install DCACHE a second time, an error message will be printed along with the allowable commands.

Caching methods

Before describing the inner workings of DCACHE, I will discuss how caches work in general. Although I'll focus on disk caches, the concepts can be applied to other types of caches as well. One point to be clear about at the outset is that DCACHE does not know or care what data it is caching. (This is typical of most types of caches.) DOS's organisation of a disk using file allocation tables, clusters, and partitions is completely independent of DCACHE. This is the reason DCACHE treats a physical disk that contains several 'logical' (partitioned) drives as a single disk. DCACHE simply caches data depending on what sectors are read and written.

There are two data areas in a cache, one large and one quite small. The larger of the two areas holds the actual disk data. The data area is subdivided into units called pages, which are the smallest blocks of data the cache will read from the disk. The second, smaller area is called the cache directory. The cache directory holds labels, called tags, which describe where the data in each page came from. For each page in the cache there is a corresponding tag in the cache directory.

The data on a disk drive is organised in pages that are the same size as the pages in the cache. A page on the disk is addressed by the logical sector number of the first sector in the page. The logical sector number is computed in the same way that DOS does it: by numbering each sector sequentially, starting with the first sector of the first head on the first cylinder of the disk. This numbering is continued up to the last sector of the last head on the last cylinder of the disk.

A page may be composed of one or more sectors. The cache reads data from the disk in multiples of pages. If DOS requests only part of a page, the cache still reads an entire page but passes only the requested sectors of the page to DOS. The cache saves the entire page in case DOS requests other sectors from the page in the future. These pages are designed to be at least as large as the average number of sectors requested from the disk. If data tends to be requested sequentially, then it is a good idea for the page to be larger than the average request. By reading ahead of the actual requests, the cache is more likely to have the data when it is requested. The page size must be limited, however, because the larger the page, the smaller the number of pages in the cache.

Each time the disk is read, the cache checks the cache directory to see if the requested data is in the cache. When it is, this is considered a 'hit'. If the data is not in the cache, and the cache has to request it from the disk, the request is considered a 'miss'. The performance of a cache is measured by the percentage of hits compared with the total number of accesses. This percentage is called the 'hit rate' of the cache.

The most important question when designing a cache is what data should be kept there. These rules define the caching algorithm. I'll discuss three basic caching algorithms here — the associative, direct mapping, and set associative. In each case I'll give an example of how such a cache, with 16 pages of eight sectors each, would be organised. The logical sector number for the example will be 16 bits wide.

Associative caches

The associative cache is the best performer in terms of hit rate. In an associative cache, data from the disk is stored anywhere there is a free page. Once the page is in the cache, the tag for that page is placed in the corresponding location in the cache directory. If there are no free pages in the cache, a page currently in the cache is replaced by the new page. DOS contains a small associative cache internally. This cache is explained in the box 'Buffers, DOS's own cache'.

As shown in Fig 1A, in an associative cache the logical sector number is divided into the tag and the page index. The page index is the address of an individual sector within a page. The tag is

Hidden gold in the PS/2

If you're like me, the instructions are the last thing you look at when setting up a computer. IBM knows this and has simplified the setup of the new PS/2s. The wordless, poster-size drawings are, for the most part, self-explanatory. But if you tear through the box too quickly, you'll miss one of the nicest pieces of software IBM has produced. Literally hidden on the reference diskette provided with the computer is a program called IBMCACHE.COM. This program installs a disk cache on your PS/2 that dramatically improves the speed of the hard disk. To run the program, put the reference diskette into drive A: and enter A:IBMCACHE. A menu-driven program guides you through the installation process.

There are a few differences between IBMCACHE and DCACHE. IBMCACHE is more flexible: it allows page sizes of two, four, or eight sectors, as against DCACHE's fixed eight-sector page size. IBMCACHE installs itself as a device driver rather than as a terminate-and-stay-resident .COM file. IBMCACHE can use extended memory to hold the cache, but it cannot use expanded memory. DCACHE, on the other hand, can use expanded memory but not extended memory. Version 2 of IBMCACHE can support caching of diskette drives, while DCACHE caches only fixed disks. The last difference is availability. While DCACHE is available through Microtex, IBMCACHE is available only by buying an IBM PS/2.

composed of the bits of the logical sector number that are not included in the page index. When DOS requests data, the cache converts the logical sector number into a tag by discarding the four least significant bits. The cache then compares the new tag with each tag in the cache directory. That's because any page in the cache can contain any page from the disk. If the new tag matches a tag in the directory, the cache reads the data from the corresponding page in the cache. For example, if the tag matched the fourth tag in the directory, the data would be found in the fourth page in the cache. If the tag is not found in the cache directory, the cache overwrites a page currently in the cache and the old tag is replaced by the new tag.

The process of choosing which page to overwrite with new data is the most important consideration in designing an associative cache. Usually the cache replaces the page that has not been used for the longest time. This is called the least recently used (LRU) algorithm. There are many other types of replacement algorithms, however, including some so complex that because of the time it takes them to compute, the cache is slower than just randomly replacing a page. The science of developing efficient replacement algorithms involves heavy mathematics, rather beyond the scope of this column. In general, however, the replacement algorithm is chosen only after carefully researching what types of requests the processor will be making of the disk.

While the associative cache is the best performer in terms of hit rate, it presents two problems in implementation. First, if

Buffers, DOS's own cache

DOS uses a small cache to keep the most recently used sectors in RAM. The size of this cache is set with the BUFFERS command in the CONFIG.SYS file. DOS uses associative caching with the least recently used replacement scheme and a page size of one sector.

The associative scheme used by the DOS cache is optimised for a small number of buffers. Using a large number of buffers improves the performance for random disk reads. However, it also degrades the performance of the associative cache for sequential reads. Prior to version 3.3, DOS automatically set the number of buffers at two for PCs and three for AT machines. DOS 3.3 sets the number of buffers from two to 15, depending on the capacity of the disks and amount of RAM in the system. The DOS manual contains a good explanation of the BUFFERS command.

Since DOS buffers are optimised for random reads and DCACHE is optimised for sequential reads, it would be nice if both could be used together. Unfortunately, using two caches together does little to improve the speed of the system. Since DOS typically reads data sequentially, however, you should notice improved disk speeds by using DCACHE rather than a large number of buffers. When using DCACHE you should reduce the number of buffers to three. Three buffers allow adequate performance for floppy disks (which are not cached by DCACHE), while freeing memory previously used by the buffers. Remember, if you are using DOS 3.3 you must specify BUFFERS = 3 to ensure that DOS does not automatically allocate a larger number of buffers.

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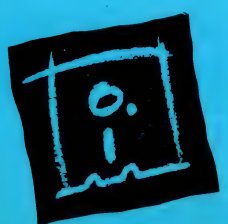
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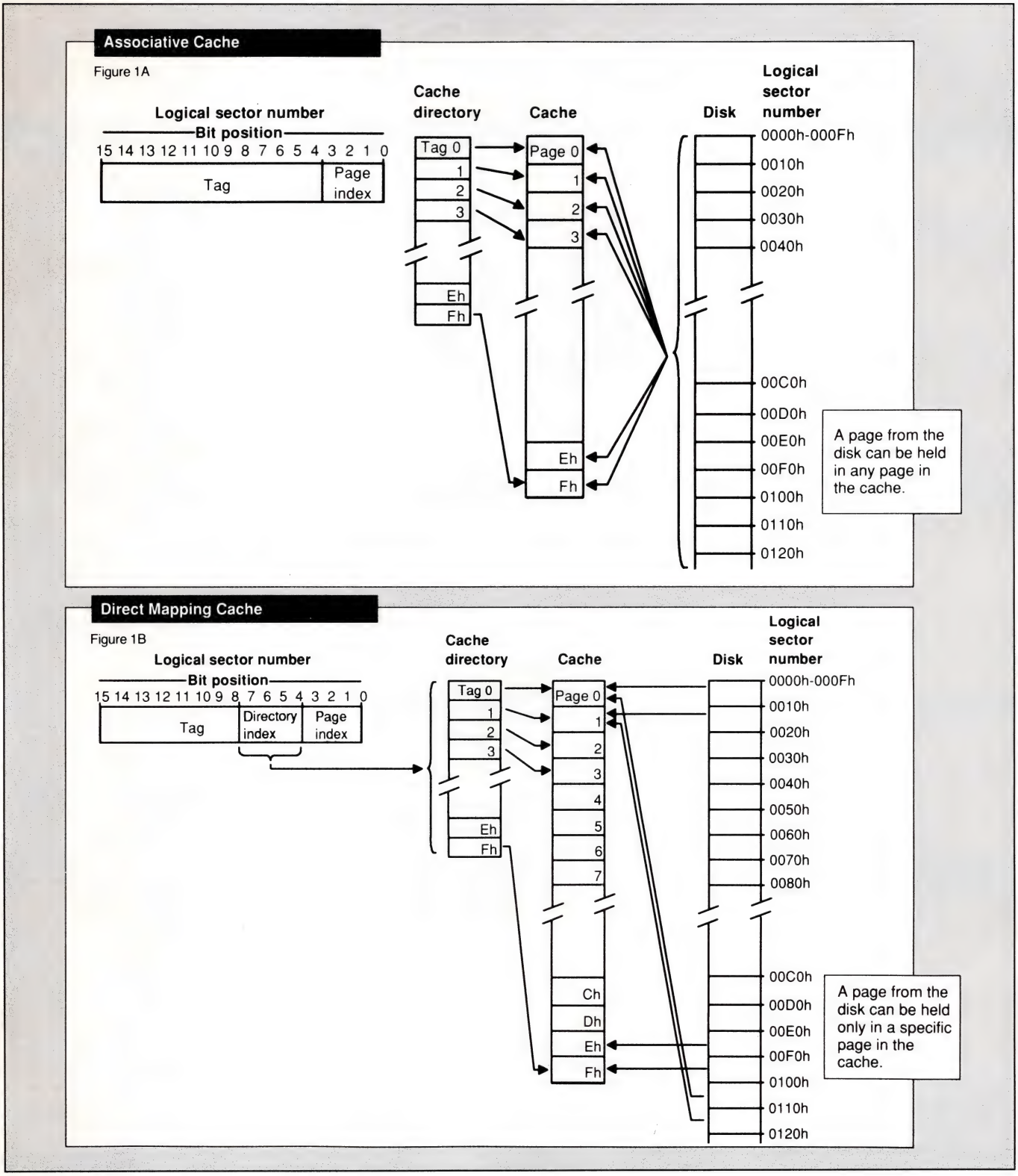


Fig 1 Neither words nor pictures alone can fully describe the three disk caching methodologies. These illustrations will help you visualise the different parts of a cache as you read through the text

it's large, the search for the corresponding tag in the cache directory takes a long time. Since this search must be made for each disk access, the overall performance of the cache is reduced. Second, the computation of the replacement algorithm can also take a long time. Even using the LRU algorithm previously described, the task of keeping track of when each page was last used can chew up precious time, the very resource the cache is trying to save.

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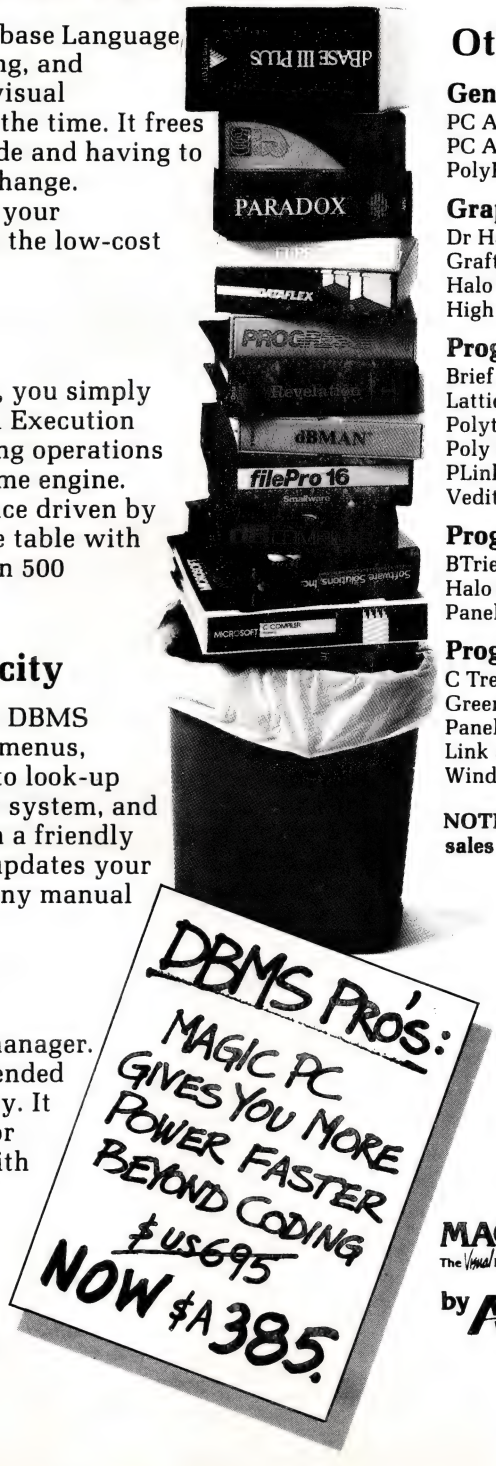
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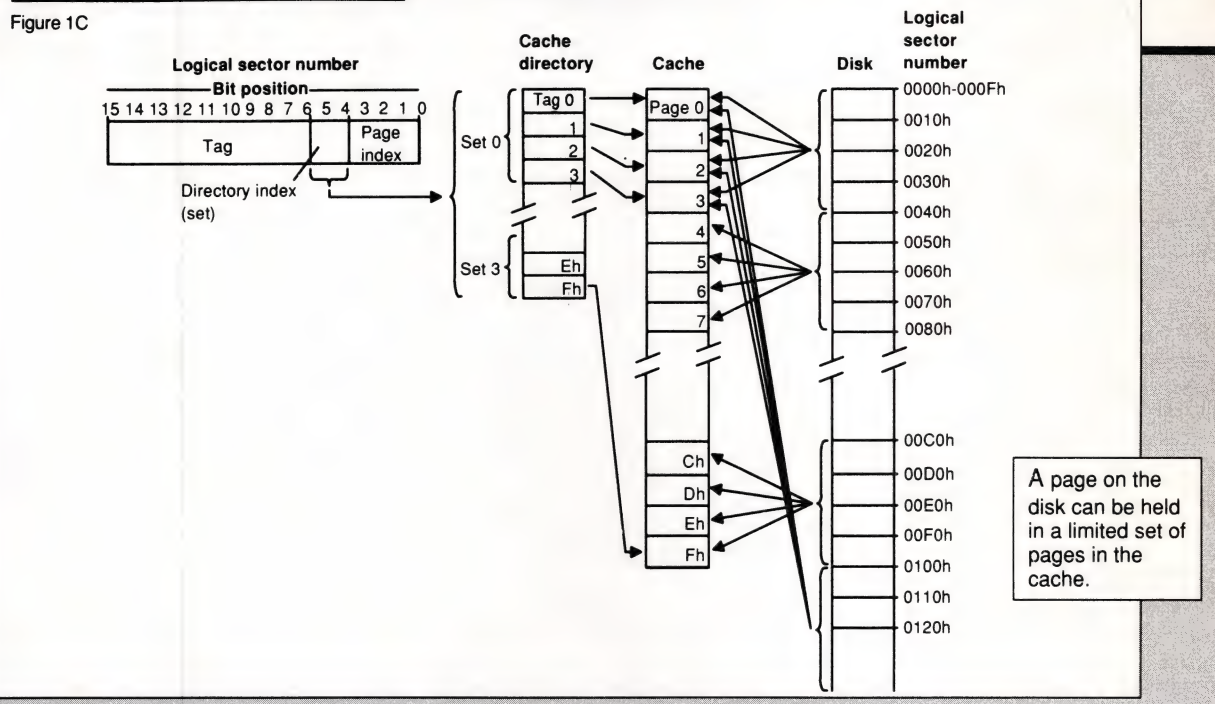
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Set Associative Cache

Figure 1C



Direct mapping cache

The direct mapping algorithm approaches the problem from a different angle. This algorithm uses part of the tag as an address to indicate what page of the cache can hold that particular page of data. The remaining bits of the tag not used in the address are used like the tag in the associative cache. Fig 1B shows how the logical sector number is divided into the page index, directory index and tag. The tag contains the logical sector number, bits 8-15. The directory index is the address within the cache directory of the tag. For example, if DOS requests a read of logical sector 2357h, the cache will look in address five of the directory. If the tag is 23, the data for sectors 2350h-235Fh is stored in the fifth page of the cache. The cache then returns sector seven of page five to DOS to satisfy the read request. If the tags do not match, the cache knows that the data is not in the cache since the directory index forces this particular sector to be in page five if it is in the cache at all.

The limiting factor in a direct mapping cache is that a given sector can be stored in only a specific page of the cache. Because each page in the cache must be responsible for more than one page on the disk, it's quite possible for one page to be replaced by another page, even if there are unused pages in the cache. In the above example, page five of the cache is responsible for caching any section with a five as the third hex digit of the sector number. The limitation of a direct mapping cache becomes apparent when two frequently used sectors lie in different pages that are assigned to the same cache page. If the two sectors are read alternately, the cache continually swaps the two pages in and out of the cache and the hit rate of the cache falls to zero. The possibility of this swapping decreases as the size of the cache increases because each page is responsible for caching fewer pages on the disk.

While the idea of limiting the pages where a given sector can be cached seems to be a bad idea, the direct mapping algorithm does have its advantages. First, by using the directory index field, the cache knows exactly where to look to see if a sector is in the cache. This localisation allows for a quick check to see if the access is a hit or a miss. Second, the replacement algorithm is trivial, since a given sector can be stored in only one place in the cache. Third, the width of the tag is reduced. Although this last reason may seem inconsequential, a narrow tag is important for hardware implementations of a cache.

Set associative cache

The set associative cache is a compromise between the associative cache and the direct mapping cache. As in the direct mapping cache, the set associative cache divides the address into the page index, directory index and the tag.

The difference between the direct mapping cache and the set associative cache is that the directory index only partially specifies the page where the data is stored. In order to determine if the data is actually in the cache, the tags for the remaining pages are searched as in the associative cache. The name 'set associative' derives from the fact that the directory index narrows the search for the current tag down to a set of pages located in the cache.

Fig 1C illustrates the way that the logical sector number is divided in a set associative cache. Notice that the directory index field is now called the set. As in the direct mapping cache, the size of the cache is still 16 pages; however, the directory index field, or set, is now only two bits wide.

The cache is divided into four sets of four pages each. If DOS requested sector number 2357, the cache would look at bits four and five in order to determine the set number, which is one. The cache would then compare the four tags in set one with the tag made up of the 10 most significant bits of the logical sector number.

The set associative cache is a good compromise between the high hit rate of the associative cache and the quick ability of the direct mapping cache to check for a matching tag. Hit rates for

the set associative cache are very close to the fully associative cache, without the need for a time-consuming search of the entire cache directory.

Understanding DCACHE

Since the source code for DCACHE is well commented and is, for the most part, simple and straightforward, I'll concentrate here on the general concepts behind the operation of the program rather than give a blow-by-blow account of how the code works. DCACHE intercepts calls to BIOS interrupt 13h, which is ultimately used by the PC to process all disk operations.

A resident program will consume less RAM if the nonresident code is made as functional as possible. In the case of DCACHE, the installation code is actually longer than its resident portion. The installation code checks for copies of DCACHE already in memory, processes the command line, provides short help messages, and, if necessary, installs the cache. The nonresident code can change the enabled flag of an already installed cache by replacing interrupt 13h and deallocating the memory. If DCACHE is executed after another copy of the code has already been installed, the new copy simply finds the installed code by searching for the copyright header of the installed copy.

The installation code has its own programming strategy to improve performance and use memory efficiently. The installation code is actually divided into two parts. The first part of the code handles all the functions that aren't needed when resident. The second part of the installation code, which is the resident part of DCACHE, is responsible for clearing the cache directory before DCACHE terminates. Since the cache directory begins at the end of the resident code, clearing the directory writes over the rest of the installation code for large cache sizes.

Since the cache directory can vary from eight to 2048 bytes (depending on the size of the cache), DCACHE computes the size of the cache and releases all memory not needed for the cache size selected. It also releases the environment block to DOS to allow that memory to be used for other programs. The cache directory is aligned on a word boundary using the MASM EVEN pseudo-op. Since 16-bit processors like the 8086 and 80286 read memory one word at a time, aligning on a word boundary is important for improving performance when reading the cache directory. Note that I call the cache directory the 'lookup table' in DCACHE.ASM.

Using expanded memory

The Lotus/Intel/Microsoft expanded memory specification (EMS) has breathed new life into DOS. By using EMS, a program can access up to 32Mbytes of memory while still running under current versions of DOS. EMS is a paged memory system. Paged memory allows a large amount of memory to be used in small portions.

Think of how you use a word processor — you can read only the current screen being displayed. To read data more than 25 lines away from the current position of the cursor, you must use the PgUp and PgDn keys to move the data you want to the screen. The same principle is at work in a paged memory system. Although you can't access all of the memory at once, by selecting individual pages you can use each page of memory separately.

EMS 4.0, the most recent version of the expanded memory specification, provides a dazzling array of functions for manipulating a paged memory system. This may at first seem intimidating, but fortunately only a few functions are needed for most programs.

To use expanded memory, a program must perform five basic functions. First, the program must determine if expanded memory is present and functioning. Second, the program must determine the address of the EMS page frame. Third, the program must reserve the EMS memory it needs. Fourth, the program must enable the page of EMS memory it wishes to use. Fifth, the program must de-allocate its pages before it terminates. A resident program like DCACHE must add a sixth step: saving and restoring the state of the EMS driver.

Commands are issued to the expanded memory driver through interrupt 67h. As in DOS, individual functions are selected using register AH. However, the way EMS numbers its functions is confusing. Although they are numbered decimally from one to 30 in the EMS reference, the actual value passed in register AH ranges from 40h to 5Dh. Thus, to use function 7 (Get EMS version), you must pass 46h in AH. (I will use the function number given in the EMS reference, not the actual hex value passed in AH.) If, on return, AH is not zero, an error has occurred during the processing of the command.

There are two approved methods to test for the presence of the EMS driver. In the 'open handle' technique, a program uses the Open Handle request function (3Dh). The register pair DS:DX points to the ASCIIZ string EMMXXXX0. If DOS does not return an error, you can assume that the EMS driver is present or there is a file on the current disk that has the same name. Using the handle obtained, call the Device Driver Control function (44h) with AL = 0. This returns information about a device driver. If bit 7 in DX is 1, call the Device Driver Control function again with AL = 7. This returns the output status of the driver. If AL = FFh, then the driver is present and available. Use Close File Handle function (3Eh) to close the expanded memory driver.

The second method to determine if the EMS is present involves checking the interrupt vector. The DOS Get Interrupt Vector function (35h) returns ES pointing to the segment of the EMS driver. A character device driver has a device name field at offset 0Ah of the segment.

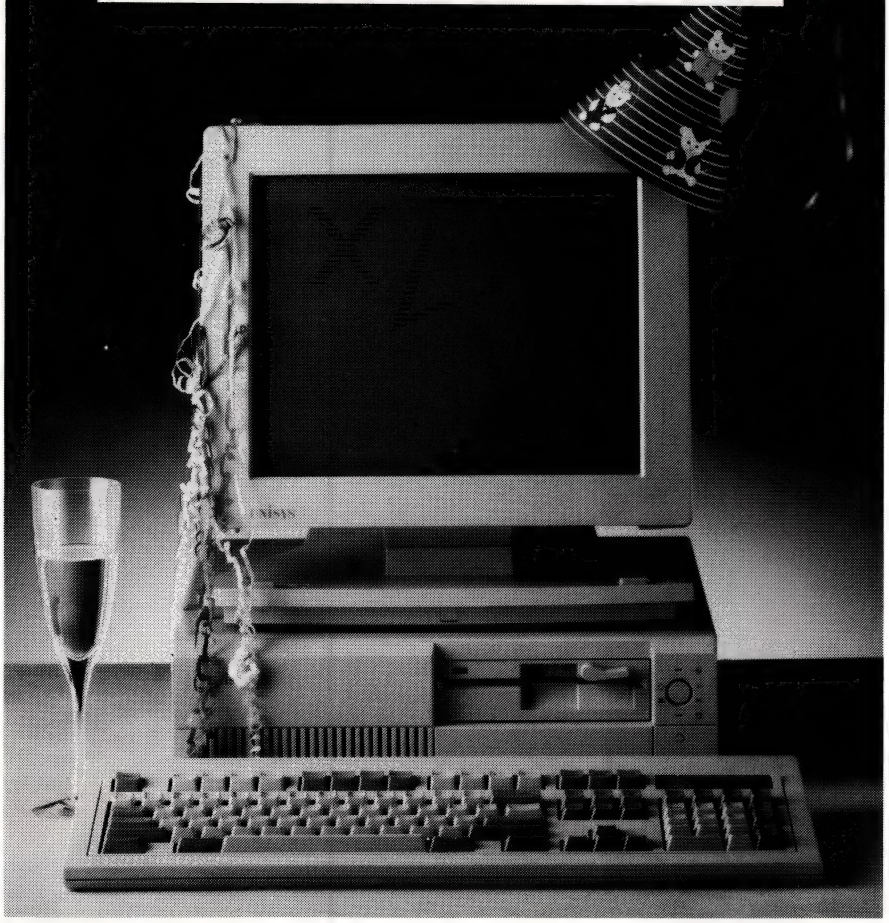
Continued . . .

If the cache is in DOS memory, the data cache is put in the very first segment after the cache directory, preventing a gap between DCACHE's resident code and the memory reserved for the cache. This is important because even if the memory in the gap were returned to DOS, it could not be used for .COM files, and it would not be large enough for most .EXE files.

The 64k segment size of Intel microprocessors presents an interesting problem when cache size exceeds 64k. To deal with this situation, DCACHE uses the ES register to point to the 16k 'segment' within the cache that contains the page needed. DCACHE uses 16k segments to be compatible with the 16k page size of expanded memory. This way, the only difference between addressing a page in expanded memory and a page in DOS memory is calling the EMS driver to make the proper page available. When using expanded memory, ES simply points to the base address of the EMS page window.

Before starting to write DCACHE, I wrote several short programs that recorded the interaction between DOS and the disk BIOS. The data from these programs helped in selecting an appropriate caching algorithm. The data showed that to maximise the performance of DOS, DCACHE should be designed to improve the speed of single-

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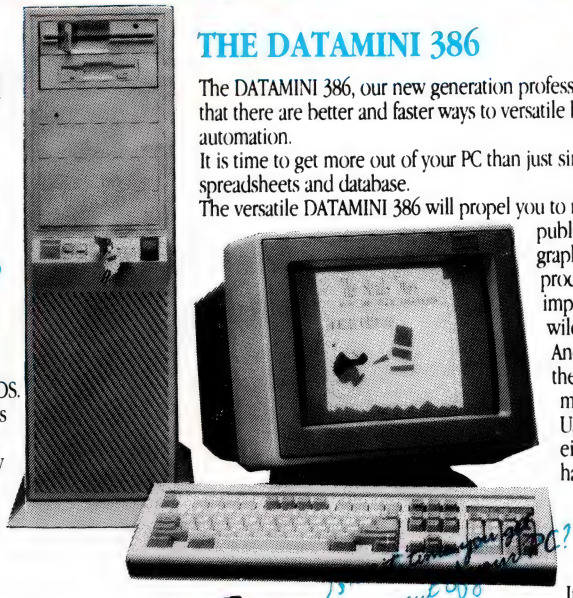
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Compare the name of the diver at offset 0Ah with the ASCII string EMMXXXX0. If the strings match, the driver is present. This technique is used by DCACHE.

Once a program determines that the EMS driver is present, it uses interrupt 67h subfunction 1, Get Status, to check the status of the driver. If AH returns a value other than zero, the driver is not functioning properly.

To get the address of the EMS page frame, use EMS function 2, Get Page Frame Address. The page frame is a 64k segment in memory where the EMS memory can be accessed, and the segment of the page frame is returned in BX.

Before a program can actually use expanded memory, it must determine if enough pages are available for its application. To determine the number of free pages in the system use function 3, Get Unallocated Page Count. This function returns the number of unallocated pages in BX and the total number of EMS pages in DX.

To allocate pages of memory, use function 4, Allocate Pages. Call this function with BX equal to the number of pages being requested. The driver will return a handle in DX. This handle must be used in future calls to the EMS driver since it references the pages that have been reserved. The EMS 4.0 specification allows up to 255 handles, though not all EMS drivers support that many. Thus, a program must check the return code in AH to assure that all handles have not been used.

Function 5, Map/Unmap Handle Pages, allows the program to access the expanded memory it has reserved. Call function 5 with AL equal to the physical page number, BX equal to the logical page number, and DX equal to the handle of the calling program. The physical page is the page number in the EMS window, and can range from zero through to three. Since the EMS window is 64k, four EMS pages can be accessed at any one time. The logical page number addresses a specific page assigned to the handle in DX. If a handle has been allocated five pages, then the pages would be addressed zero through four.

Before terminating, a program must release the pages it has been allocated. This is done by using function 6, De-allocate Pages. This gives future programs access to these pages. If a program terminates but remains resident, it is not required to release pages it still needs. It is important that a program with allocated pages trap the critical error handler and the Ctrl-break interrupts if these interrupts can occur during the program. If a program terminates under an error condition, it still must release its allocated pages.

Since terminate-and-stay-resident programs, interrupt service routines, and device drivers can be invoked at any time, the state of the EMS driver must be saved before these programs can use expanded memory. The EMS driver provides function 8 to save and function 9 to restore the state of the EMS page frame. Call function 8, Save Page Map, with DX equal to the handle of the program attempting to save the state of the driver. This is not the handle of the program being interrupted. Function 8 saves the current mapping of the EMS driver. This allows the interrupting program to remap the EMS window to access its own EMS pages. When the interrupting program is finished, it uses function 9, Restore Page Map. Like function 8, function 9 is called with DX equal to the handle of the interrupting program.

sector sequential reads. For a closer look at this data, see the box 'Disk access statistics'.

Partly for reasons of simplicity, DCACHE was designed to use the direct mapping cache algorithm. Although the hit rate for a direct mapping cache is typically lower than for an associative cache, it is still high enough to provide good performance. The direct mapping approach is also efficient for large caches, since the time needed to check the cache directory is no greater for a 1Mbyte cache than it is for a 16k cache. A page size of eight sectors was selected because this provides excellent performance for the sequential reads that DOS generally makes.

As a direct mapping cache, DCACHE divides the logical sector number into three fields. The first, the page index, is composed of the three least significant bits, which are used to find a particular sector within a page. The next field, the directory index field, varies from two to 11 bits wide, depending on the cache sizes selected. For a 16k cache, the directory index field uses only bits four and five. For each bit increase in the width of this field, the size of the cache doubles. The last division, the tag field, is composed of bits 4-9, and because of the varying size of the index field, the tag and directory index fields overlap. Having a fixed size for the tag field simplifies the code, and using 16 bits

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Disk access statistics

To design a cache properly, how DOS interacts with the disk must be understood. To do this, I wrote a small program to intercept the BIOS 13h disk interrupt. The data from this program was instrumental in the design of DCACHE.

This data was recorded while the PC was performing the average tasks of editing files, running batch files and compiling a few programs. Although the majority of users don't compile many programs, the process is similar to many other programs that manipulate files on a disk. The data from the BIOS intercept program shows quite clearly certain tendencies of DOS.

The first table in Fig A shows the typical number of sectors DOS requests from the hard disk. Note that an overwhelming per cent of the time DOS requests only one sector. The reason for this is that DOS spends relatively little time moving programs into and out of memory. Most of the time DOS is reading or writing small chunks of data at the request of programs already in memory.

The second table in Fig A shows the relative displacement of two consecutive disk operations. To create this table, I computed the logical sector number for each disk access. The logical sector number is computed by numbering each sector from sector 1, head 0, cylinder 0, up to the last sector of the last cylinder.

The displacement is computed by subtracting the logical sector number of the last disk access from the logical sector number of the current disk access. One of the interesting points of this data is that 55 per cent of the time DOS reads or writes a sector within eight sectors of the last disk access. This predictability of disk accesses indicates that a disk cache will dramatically increase the effective speed of DOS.

DOS disk requests by size and location

Disk requests by size

Sectors requested	Number of requests
1	4176
2-7	6
8-15	0
16-32	10
33-64	6
65-128	12
Total	4210

Disk requests by location

Relative displacement of consecutive disk accesses	Occurrences
0	9
1	673
2-7	25
8-15	29
16-31	30
32-63	43
64-126	176
127 and greater	280
Total	1265

Fig A The data in these tables reveals the typical pattern of DOS disk operations. Overwhelmingly, data is requested in small parcels that tend to be adjacent

conveniently allows a cache directory size of one word for every page.

The use of 19 bits for the logical sector number puts an upper limit on the size of disk that DCACHE can handle. With a sector size of 512 bytes, the maximum size of the disk is 268,434,432 bytes. Since few users have disks larger than 260Mbytes, this limitation is unlikely to be serious. To be safe, however, the initialisation code determines the number of cylinders, heads and sectors per cylinder for the disk selected and computes the largest logical sector number possible. If this maximum sector number is larger than 19 bits, installation is aborted.

DCACHE does not cache read requests larger than one page. The reason for this is twofold. First, since DOS seldom requests more than one sector at a time, there is little advantage in increasing the code size of DCACHE to handle the few occasional large reads that occur. Second, a read request for a large number of sectors is probably a program load. Since a program is usually loaded only once during its execution, caching this read would not improve the speed of the disk.

I kept one inviolable principle in mind when designing DCACHE: the program must never compromise data integrity. To ensure data integrity, DCACHE is a write-through cache. A write-through cache does not interfere with writes to the disk. DCACHE checks each write request to see if the sector to be written is in the cache. If the sector is in the cache, DCACHE will update the page in the cache, then pass the write request on to BIOS. If the number of sectors to be written is larger than a page, DCACHE erases the tags from the cache directory without trying to update the cache. DCACHE never stops DOS from writing to the disk. This method is slower than other types of write caching but it is much safer.

For any operation other than a simple read, write or check status, DCACHE resets the cache by clearing the cache directory. Again, it's better to err on the side of safety than to return incorrect data to DOS.

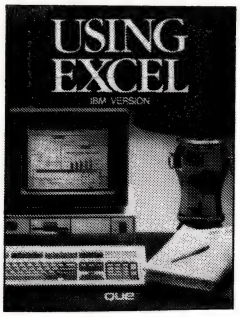
Error recovery is very important when a program inserts itself between DOS and BIOS. DCACHE uses a simple but effective technique to provide the necessary error recovery. If an error occurs during a disk read, DCACHE resets the disk system using BIOS interrupt 13h function 0. The program then restores the original DOS calling parameters and jumps to the BIOS disk routine. This process allows DOS to detect any error in the read of a specific sector, while masking any error caused by the cache reading sectors not explicitly requested by DOS.

There is a potential problem with DCACHE causing repeated disk errors and resets. Assume that DOS requests a sector in a page that contains a bad sector. DCACHE would attempt to read the entire page, including the sector with the error. Since it is likely that DOS will request a sector within the same page on the next read request, DCACHE might repeat the error each time the page is requested. To prevent this, DCACHE stores the sector number of the last page that caused a BIOS error. If that page is requested again, DCACHE simply passes the request to BIOS without attempting to cache the page.

EMS support

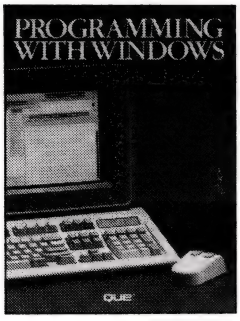
The many features of EMS made it quite easy for DCACHE to implement support of expanded memory. To use expanded memory, DCACHE must first determine if the expanded memory driver is present. To check for the driver, DCACHE reads the interrupt 67h vector in the interrupt table. If the segment points to a device driver with the label EMMXXXX0, then the EMS driver is present. After determining that the driver is present, DCACHE uses interrupt 67h function 2 to get the address of the EMS

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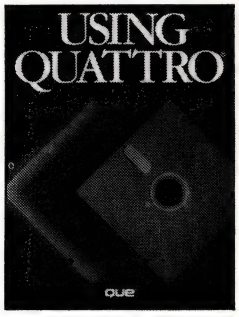
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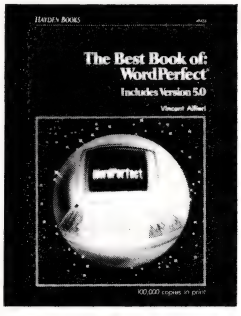
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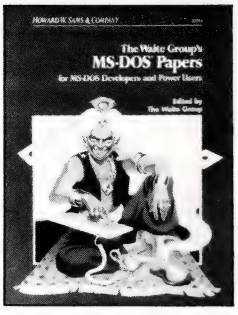
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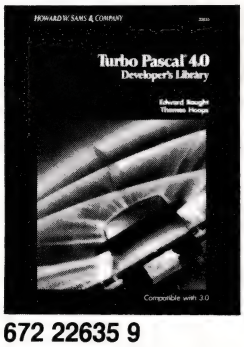
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;=============================================================================
;  DCACHE.COM - A fixed disk cache for the IBM Personal Computer.
;  PC Magazine, Vol 7 # 17
;-----------------------------------------------------------------------------
CODE            SEGMENT PARA PUBLIC 'CODE'
                ASSUME CS:CODE
                ORG     2CH
ENV_SEG         DW      ?                       ;Segment of the environment block
                ORG     80H
TAIL_LENGTH     DB      ?                       ;Length of the command tail

                ORG     100H
ENTRY:          JMP     MAIN_ENTRY
;-----------------------------------------------------------------------------
; Data Area
;-----------------------------------------------------------------------------
PROGRAM         DB      'DCACHE 1.0 (c) 1988 Ziff Communications Co.',13,10
                DB      'PC Magazine ',254,' Douglas Boling',13,10,'$',26

ENABLED         DB      1                       ;0 = cache disabled, 1 = enabled
EMS_FLAG        DB      0                       ;use EMS ram flag, 1 = use EMS
EMS_HANDLE      DW      0                       ;handle for EMS memory.

ADDR_MASK       DW      001EH                   ;Default mask set for 64K cache
SIZE_MASK       DW      0
EMS_MASK        DW      0                       ;used to sel. the proper EMS page

DISK_NUM        DB      80H                     ;number of fixed disk to cache
PAGE_SIZE       DB      8                       ;size of cache page
MAX_HEAD        DW      ?                       ;maximum value of head parameter
MAX_SECTOR      DW      ?                       ;maximum value of sector
MAX_SEGMENT     DW      ?                       ;last segment of data cache

DOSBOFFSET      DW      ?                       ;offset of dos data buffer
DOSBSEGMENT     DW      ?                       ;sector of dos data buffer
NUM_OF_SEC      DB      ?                       ;number of sectors requested
DISK_FUNCT      DB      ?                       ;function requested
SECTOR_NUM      DW      ?                       ;sector parameter from dos call
HEAD_NUM        DB      ?                       ;head parameter
CYLINDER_NUM    DW      ?                       ;cylinder parameter

SEGMENT_PTR     DW      0                       ;pointers into the cache
PAGE_PTR        DW      0

LOG_SEC_HIGH    DW      0                       ;Logical sector number of disk
LOG_SEC_LOW     DW      0                       ;  request.
LAST_BAD_PAGE   DW      -1                      ;stores the last page that
                                                ;contained an error
LOOKUPTABLE     DW      OFFSET DATA_START       ;offset of lookup table
CACHE_SEGMENT   DW      0                       ;segment of cache data

OLD_DISK_INT    LABEL   DWORD                   ;old bios interrupt 13h vector
OLD_INT13H      DW      2 DUP (?)
;-----------------------------------------------------------------------------
; This routine intercepts the bios disk calls.
; Entry: ah - disk function      (All other registers specific to disk read.)
;        al - number of sectors                es:bx - pointer to data buffer
;        ch - Cylinder number                     dh - Head number
;        cl - 7,6 cyl. high. 5-0 sector number    dl - drive number
;-----------------------------------------------------------------------------
DISK_INT        PROC    FAR
                ASSUME CS:CODE,DS:NOTHING,ES:NOTHING
                CMP     CS:ENABLED,0            ;See if cache enabled
                JE      SKIP_CACHE
                CMP     DL,CS:DISK_NUM          ;See if the correct disk
                JNE     SKIP_CACHE
                STI                             ;Allow interrupts
                CMP     AH,2                    ;If any other function besides
                JE      CACHE_IT                ;  read or write, reset cache.
                CMP     AH,3
                JE      CACHE_IT1
                CMP     AH,1                    ;If just checking the last status
                JE      SKIP_CACHE              ;  skip cache, but don't reset.
RESET_CMD:
                PUSH    ES                      ;If the command is not a simple
                PUSH    CS                      ;  read, write, or status, assume
                POP     ES                      ;  the worst and clear the lookup
                ASSUME ES:CODE                  ;  table.
                CALL    RESET_CACHE
                POP     ES
                ASSUME ES:NOTHING
SKIP_CACHE:
                JMP     CS:OLD_DISK_INT         ;jmp to bios disk routine.
;-----------------------------------------------------------------------------
;Compute the logical sector number from the cylinder, head, and sector.

;-----------------------------------------------------------------------------
CACHE_IT:
                CMP     AL,CS:PAGE_SIZE         ;For disk read, cache reads of
                JA      SKIP_CACHE              ;  a page or less.
CACHE_IT1:
                PUSH    DS                      ;save registers
                PUSH    DI
                PUSH    SI
                PUSHF
                PUSH    AX
                PUSH    BX
                PUSH    CX
                PUSH    DX
                PUSH    CS                      ;set ds to code segment
                POP     DS
                ASSUME DS:CODE
;-----------------------------------------------------------------------------
;Store calling parameters.
;-----------------------------------------------------------------------------
                MOV     DOSBOFFSET,BX           ;save dos pointer to its data
                MOV     DOSBSEGMENT,ES          ;  buffer.
                MOV     BX,CX                   ;copy cx
                AND     BX,003FH                ;strip all but the sector number
                MOV     SECTOR_NUM,BX           ;save sector number
                MOV     HEAD_NUM,DH             ;save head number
                MOV     NUM_OF_SEC,AL           ;save the number of sectors needed
                MOV     DISK_FUNCT,AH           ;save function called.
;-----------------------------------------------------------------------------
;Compute logical sector number from the cylinder, head, and sector parameters.
;-----------------------------------------------------------------------------
                XCHG    CL,CH                   ;create full 10 bit cylinder num.
                ROL     CH,1                    ;  the top 2 bits are in ch bits
                ROL     CH,1                    ;  7 and 6. roll them into bits
                AND     CH,03H                  ;  1 and 2.
                MOV     CYLINDER_NUM,CX         ;save the cylinder number
                MOV     AX,CX                   ;copy cylinder number for multiply
                MOV     BL,DH                   ;get head number out of dx
                MUL     MAX_HEAD                ;multiply cylinder to make room
                XOR     BH,BH                   ;clear high byte of head value
                ADD     AX,BX                   ;add in head.
                MUL     MAX_SECTOR              ;multiply by max sector value
                ADD     AX,SECTOR_NUM           ;add sector number
                ADC     DX,0                    ;propigate carry.
                MOV     LOG_SEC_HIGH,DX         ;save logical sector number
                MOV     LOG_SEC_LOW,AX
;-----------------------------------------------------------------------------
;Store values needed later.
;-----------------------------------------------------------------------------
                MOV     BH,AL
                SHL     BH,1
                AND     BX,3E00H
                MOV     PAGE_PTR,BX             ;save page index
                AND     BH,3FH
                MOV     SI,BX                   ;save page index for cache load
;-----------------------------------------------------------------------------
;Point the segment register to the proper DOS memory block
;-----------------------------------------------------------------------------
                MOV     BX,AX                   ;copy logical sector low
                MOV     CL,5
                SHL     BX,CL                   ;Convert logical sector number to
                AND     BX,SIZE_MASK            ;  cache page index
                ADD     BX,CACHE_SEGMENT
                MOV     SEGMENT_PTR,BX          ;save segment index
                MOV     BX,AX                   ;copy logical sector number
                MOV     DI,LOOKUPTABLE          ;use di to point to lookup table
;-----------------------------------------------------------------------------
;Check for a read or a write
;-----------------------------------------------------------------------------
                CMP     DISK_FUNCT,2
                JNE     DISK_WRITE
                JMP     DISK_READ
;-----------------------------------------------------------------------------
;Process bios write calls.
;-----------------------------------------------------------------------------
DISK_WRITE:
                MOV     CL,AL                   ;See if the write crosses a page
                AND     CL,07H                  ; boundry. If > 8, it does.
                MOV     CH,NUM_OF_SEC
                ADD     CL,CH
                CMP     CL,PAGE_SIZE            ;If the write crosses a page
                JA      WRITE_UPDATE_SKP        ;  boundry, skip the update and
                CMP     EMS_FLAG,0              ;  just purge the cache.
                JE      WRITE_SKP_EMS
                CALL    EMS_SETUP               ;access the EMS page bx=logsec_low
WRITE_SKP_EMS:
                PUSH    AX
                CALL    CHECK_HIT               ;Check to see if the data is in
                POP     AX                      ;  the cache.
                JNE     EXIT_AND_RESTORE        ;If miss, skip all this stuff
;-----------------------------------------------------------------------------
;Since the data is in the cache, update just the stuff to be written
;-----------------------------------------------------------------------------
                XOR     CL,CL
                MOV     DI,PAGE_PTR             ;Load the pointers for the data
                MOV     SI,DOSBOFFSET           ;  move. ch already contains the
                MOV     ES,SEGMENT_PTR          ;  number of sectors to move. cx
                MOV     DS,DOSBSEGMENT          ; then contains the number of
                ASSUME DS:NOTHING,ES:NOTHING    ;  words to move.
                CLD
                REP     MOVSW                   ;Copy the data to be written into
                PUSH    CS                      ;  the cache.
                POP     DS
                ASSUME DS:CODE
                JMP     SHORT EXIT_AND_RESTORE
;-----------------------------------------------------------------------------
;If the write crosses a page boundry, just delete the entry from the table.
;-----------------------------------------------------------------------------
WRITE_UPDATE_SKP:
                MOV     SI,AX                   ;Save logical sector low logical
                MOV     CL,PAGE_SIZE            ;  sector high will be fine in dx.
                DEC     CH
DISK_WRITE1:
                CMP     CH,CL                   ;If the number of sectors is less
                JA      DISK_WRITE2             ;  than the page size, decriment
                MOV     CL,CH                   ;  by the number of sectors
DISK_WRITE2:
                PUSH    CX
                CALL    CHECK_HIT                 ;Check to see if the sector
                POP     CX
                JNE     DISK_WRITE3               ;is in table. Purge the tag if

                MOV     WORD PTR [DI][BX],0FFFFH ;this is a hit.
DISK_WRITE3:
                PUSH    SI                      ;Save copy of logical sector num
                SUB     CH,CL
                MOV     BL,CL                   ;Subtract the page size from the
                XOR     BH,BH                   ;  number of sectors written. Add
                ADD     SI,BX                   ;  to the logical sector number.
                ADC     DL,0
                MOV     AX,SI                   ;Move logical sector low to ax.
                POP     BX                      ;Get sector before add for compare
                XOR     BX,AX                   ;If there is no difference in the
                TEST    BL,08H                  ;  logical page after the inc then
                JNZ     DISK_WRITE1             ;  exit the loop.
;-----------------------------------------------------------------------------
;restore the registers for the bios call.
;-----------------------------------------------------------------------------
EXIT_TO_BIOS:
                POP     DX                      ;jump to the bios interrupt as if
                POP     CX                      ;  we were not here.
                POP     BX
                POP     AX
                POPF
                MOV     ES,DOSBSEGMENT
                POP     SI
                POP     DI
                POP     DS
                JMP     CS:OLD_DISK_INT
;-----------------------------------------------------------------------------
;Exit to bios and restore EMS if necessary
;-----------------------------------------------------------------------------
EXIT_AND_RESTORE:
                CMP     EMS_FLAG,0
                JE      EXIT_TO_BIOS
                MOV     AH,4BH                  ;Restore EMS configuration
                MOV     DX,EMS_HANDLE
                INT     67H
                OR      AH,AH
                JE      EXIT_TO_BIOS
INT_EMS_ERR:
                MOV     ENABLED,0               ;EMS error, assume the worst and
                JMP     SHORT EXIT_TO_BIOS      ;  disable the cache.
;-----------------------------------------------------------------------------
;Process bios read calls.
;-----------------------------------------------------------------------------
DISK_READ:
                ASSUME DS:CODE
;If using Expanded memory, get the needed segments.
                CMP     EMS_FLAG,0
                JE      INT_DOS_MEM
                CALL    EMS_SETUP
INT_DOS_MEM:
```

continued . . .

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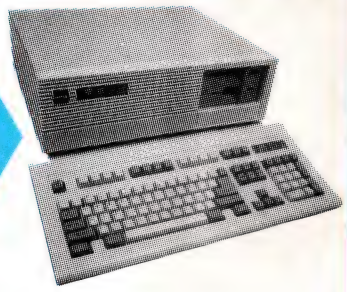
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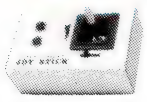
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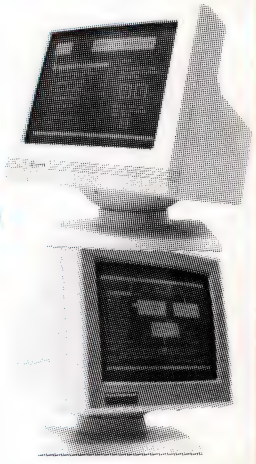
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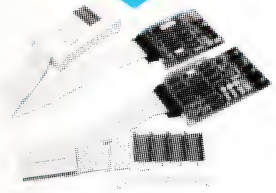
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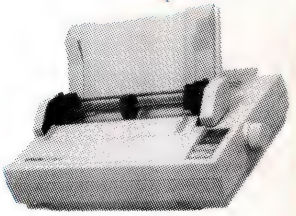
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```
;-------------------------------------------------------------------------
;Convert logical sector number to an index into the lookup table.
;-------------------------------------------------------------------------
            XOR     CL,CL                   ;clear sector counter
            CALL    CHECK_HIT               ;see if we have a hit
            CMP     AX,LAST_BAD_PAGE        ;If this page has a bad sector
            JE      EXIT_AND_RESTORE        ;  don't fetch it.
            MOV     WORD PTR [DI][BX],AX    ;update the look up table.
;-------------------------------------------------------------------------
;if we need 2 pages, check to see if the other page is in the cache
;-------------------------------------------------------------------------
            MOV     AX,LOG_SEC_LOW          ;Add the number of sectors needed
            MOV     CH,AL                   ;  to the displacment in the page
            AND     CH,07H                  ;  if > 8, we need 2 pages.
            ADD     CH,NUM_OF_SEC
            CMP     CH,PAGE_SIZE
            JLE     END_OF_CHK              ;we only need 1 page
            CMP     SI,3200H
            JNE     CHK_2ND_PAGE
            MOV     DX,SEGMENT_PTR          ;check to see if we are at the
            CMP     DX,MAX_SEGMENT          ;  very top of the cache and we
            JB      CHK_2ND_PAGE
            MOV     [DI][BX],0FFFFH         ;clear lookup table
            JMP     SHORT EXIT_AND_RESTORE  ;skip cache.
;-------------------------------------------------------------------------
;adjust the index into the lookup table to check for the second page.
;-------------------------------------------------------------------------
CHK_2ND_PAGE:
            MOV     DX,LOG_SEC_HIGH         ;we need 2 pages, check to see if
            XOR     BH,BH                   ;  the other page is in the cache.
            MOV     BL,NUM_OF_SEC
            ADD     AX,BX                   ;Do this by adding the number of
            ADC     DL,0                    ;  sectors needed to the starting
            CALL    CHECK_HIT               ;  logical sector number.
            JE      END_OF_CHK              ;skip next if second page hit.
            MOV     WORD PTR [DI][BX],AX    ;update the look up table.
            MOV     AL,PAGE_SIZE
            CMP     CL,AL                   ;If we need only the second page,
            JNE     END_OF_CHK              ;  adjust the starting pointers
            ADD     SI,1000H                ;  into the cache.
            XOR     AH,AH
            ADD     LOG_SEC_LOW,AX
            ADC     LOG_SEC_HIGH,0
END_OF_CHK:
;-------------------------------------------------------------------------
;Now that we have checked for the data in the cahe, jump to the right routine
;-------------------------------------------------------------------------
            CMP     CL,0                    ;check the number of sectors to
            JE      CACHE_HIT               ;  read from the disk.
;-------------------------------------------------------------------------
;The request is a cache miss. Load the data needed from the disk to the cache.
;-------------------------------------------------------------------------
CACHE_MISS:
            XOR     CH,CH
            MOV     DI,CX                   ;save the number of sectors needed
;-------------------------------------------------------------------------
;Use the logical sector number to compute the new calling parameters.
;-------------------------------------------------------------------------
            XOR     CX,CX                   ;clear a place for the sector num
            MOV     DX,LOG_SEC_HIGH         ;put the logical sector number
            MOV     AX,LOG_SEC_LOW          ;  into dx,ax
            AND     AX,0FFF8H               ;clear off the odd sector
            JNE     SET_REGS                ;if the resulting logical sector
            OR      DX,DX                   ;  number is 0, modify the calling
            JNE     SET_REGS                ;  parameters to allow for the
            INC     AX                      ;  sectors starting at 1.
            ADD     SI,200H                 ;si holds the cache target address

            DEC     DI                      ;di holds the number of sectors
SET_REGS:                                   ;  to fetch.
            DIV     MAX_SECTOR
            OR      CX,DX                   ;save the remainder (sector num)
            JNE     SET_REGS1               ;Since the sector number can not
            MOV     CX,MAX_SECTOR           ;  be zero, check for this and
            DEC     AX                      ;  correct if necessary.
SET_REGS1:
            XOR     DX,DX                   ;remove the remainder
            DIV     MAX_HEAD
;-------------------------------------------------------------------------
;put cylinder and sector parameters into their proper registers.
;-------------------------------------------------------------------------
            MOV     DH,DL                   ;move head to proper register.
            XCHG    AL,AH                   ;Put the cylinder number into the
            ROR     AL,1                    ;  strange, but required registers
            ROR     AL,1
            OR      CX,AX
;-------------------------------------------------------------------------
;Compute data buffer inside cache.
;-------------------------------------------------------------------------
            MOV     BX,SI                   ;Point the data buffer for the
            MOV     ES,SEGMENT_PTR          ;  call to the proper cache page.
            ASSUME ES:NOTHING
;-------------------------------------------------------------------------
;complete the parameters for the bios call.
;-------------------------------------------------------------------------
            MOV     AX,DI                   ;get the number of sectors to read
            MOV     AH,02H                  ;read data from disk
            MOV     DL,DISK_NUM             ;access the correct disk
;-------------------------------------------------------------------------
;Set up parameters and call real bios int 13h.
;-------------------------------------------------------------------------
            PUSH    AX
            PUSHF
            CALL    OLD_DISK_INT
            POP     SI
            JC      BIOS_ERROR              ;if an error ocurred, deal with it
;-------------------------------------------------------------------------
;Cache hit. Transfer the data from the cache to the dos buffer.
;-------------------------------------------------------------------------
CACHE_HIT:
            MOV     DI,DOSBOFFSET           ;Load es:di with the dos data
            MOV     ES,DOSBSEGMENT          ;  buffer.
            ASSUME ES:NOTHING
            MOV     CH,NUM_OF_SEC           ;Put number of words to transfer
            XOR     CL,CL                   ;  into cx.
            MOV     SI,PAGE_PTR             ;Load ds:si with the location of
            MOV     DS,SEGMENT_PTR          ;  the data in the cache.
            ASSUME DS:NOTHING
            CLD
            REP     MOVSW                   ;Transfer the data from the cache
            PUSH    CS
            POP     DS
            ASSUME DS:CODE
EXIT_TO_CALLER:                             ;  to the caller of int 13h
;-------------------------------------------------------------------------
;Restore EMS configuration if necessary.
;-------------------------------------------------------------------------
            CMP     EMS_FLAG,0              ;Check to see if we are using
            JE      CALLER_EXIT_SKIP        ;  ems memory.
            MOV     AH,48H
            MOV     DX,EMS_HANDLE           ;If so, restore the mapping
            INT     67H                     ;  context used before this
            OR      AH,AH                   ;  interrupt.
            JE      CALLER_EXIT_SKIP
            JMP     INT_EMS_ERR
CALLER_EXIT_SKIP:
            POP     DX
            POP     CX
            POP     BX
            POP     AX
            POPF
            XOR     AX,AX                   ;Clear ax to indicate 0 return
            POP     SI                      ;  code.
            POP     DI
            POP     DS
            CLC                             ;Clear carry to indicate no error.
            RET     2                       ;Return but keep current flags
;-------------------------------------------------------------------------
;Error routine
;-------------------------------------------------------------------------
BIOS_ERROR:
            ASSUME DS:CODE
            MOV     AX,LOG_SEC_LOW          ;Get logical sector, convert it
            MOV     DX,LOG_SEC_HIGH         ;  into an index into the
            MOV     DI,LOOKUPTABLE          ;  lookup table, then erase the
            CALL    CHECK_HIT               ;  tag.
            MOV     WORD PTR [DI][BX],0FFFFH
            MOV     CX,SI                   ;See if we were reading 2
            CMP     CL,PAGE_SIZE            ;  pages. If so, clear next
            JLE     BIOS_ERROR1             ;  entry in the lookup table.
            ADD     BX,2
            MOV     WORD PTR [DI][BX],0FFFFH
BIOS_ERROR1:
            MOV     LAST_BAD_PAGE,AX
            XOR     AX,AX
            MOV     DL,DISK_NUM             ;Reset disk system using
            PUSHF                           ;  bios int 13 function 0.
            CALL    OLD_DISK_INT
            JMP     EXIT_AND_RESTORE
DISK_INT    ENDP
;-------------------------------------------------------------------------
;EMS Setup This routine saves the current state of the EMS driver, then
;       loads in the proper EMS page needed for the cache.
;Entry: bx - low word of logical sector number
;-------------------------------------------------------------------------
EMS_SETUP   PROC    NEAR
            ASSUME DS:CODE
            PUSH    AX
            PUSH    DX
            MOV     CL,5
            SHR     BX,CL                   ;Convert logical sector num to
            AND     BX,EMS_MASK             ;  a physical EMS page number.
;-------------------------------------------------------------------------
;Save current state of EMS driver
;-------------------------------------------------------------------------
            MOV     AH,47H                  ;Save state function
            MOV     DX,EMS_HANDLE
            INT     67H                     ;call EMS driver

            OR      AH,AH                   ;check for error
            JNE     EMS_SETUP_ERR
;-------------------------------------------------------------------------
;Get the proper EMS pages from the EMS driver.
;-------------------------------------------------------------------------
            MOV     AX,4400H                ;map EMS memory to cache segment
            INT     67H
            OR      AH,AH                   ;check for EMS error
            JNE     EMS_SETUP_ERR
            POP     DX
            POP     AX
            RET
EMS_SETUP_ERR:
            ADD     SP,6                    ;clean up stack
            JMP     INT_EMS_ERR
EMS_SETUP   ENDP
;-------------------------------------------------------------------------
;Check hit. This routine checks the lookup table for a match.
;Entry: dl,ax logical sector number.  Exit: ZF set = hit,  ZF clear, miss
;       cl = number of sectors to fetch      cl = updated number of sectors
;       di = base of lookup table
;-------------------------------------------------------------------------
CHECK_HIT   PROC    NEAR
            ASSUME DS:CODE
            AND     AX,0FFF8H               ;remove the page index.
            OR      AX,DX                   ;add in the top 3 bits
            MOV     BX,AX                   ;copy the log sec num to bx to
            SHR     BX,1                    ;  create the table index.
            SHR     BX,1
            AND     BX,ADDR_MASK            ;Use the addr mask to limit the
            CMP     AX,WORD PTR [DI][BX]    ;  size of the lookup table
            JE      CHECK_HIT1              ;Check for a hit.
            ADD     CL,PAGE_SIZE            ;cache miss, grab a page of sectors
CHECK_HIT1:
            RET
CHECK_HIT   ENDP
;-------------------------------------------------------------------------
;Reset Cache. Routine clears the cache look up table.
;Entry ds - segment of the lookup table, and the lookup table offset
;-------------------------------------------------------------------------
RESET_CACHE PROC    NEAR
            ASSUME CS:CODE,DS:NOTHING,ES:NOTHING
            PUSH    DI
            PUSH    CX
            PUSH    AX
            MOV     AX,0FFFFH
            MOV     DI,ES:LOOKUPTABLE       ;point di to the lookup table
            MOV     CX,ES:ADDR_MASK         ;compute size of the lookup table
            SHR     CX,1
            INC     CX
            REP     STOSW                   ;write ffff to each entry in the
            POP     AX                      ;  lookup table.
            POP     CX
            POP     DI
            RET
RESET_CACHE ENDP
;-------------------------------------------------------------------------
;Safe place to clear lookup table.
;-------------------------------------------------------------------------
INSTALL1:
            ASSUME DS:CODE                  ;DS points to code segment
            PUSH    CS
            POP     ES                      ;point es to lookup table segment
            ASSUME ES:NOTHING
            CALL    RESET_CACHE             ;Clear lookup table
            POP     CX                      ;get state of enable flag
            MOV     ENABLED,CL              ;Terminate and stay resident
            INT     21H                     ;  with 0 return code.
;-------------------------------------------------------------------------
;Data area not needed by resident routine.
;-------------------------------------------------------------------------
            EVEN                            ;start lookup table on even byte
DATA_START  =       $

;=========================================================================
;Non-resident code.
;-------------------------------------------------------------------------
LOOKUP_SIZE DW      0                       ;size of the lookup table
TERM_MEM    DW      0                       ;amount of memory needed at end.
ALRDY_IN_MEM DB     0                       ;flag indicating cache installed.
OTHER_SEG   DW      0                       ;segment of installed copy
EMS_HEADER  DB      'EMMXXXX0'              ;Header of EMS driver.

HELP0       DB      13,10,'Options:',13,10
            DB      '/OFF - Disable Cache',13,10
            DB      '/ON - Enable Cache',13,10
            DB      '/U - Uninstall Cache',13,10,'$'
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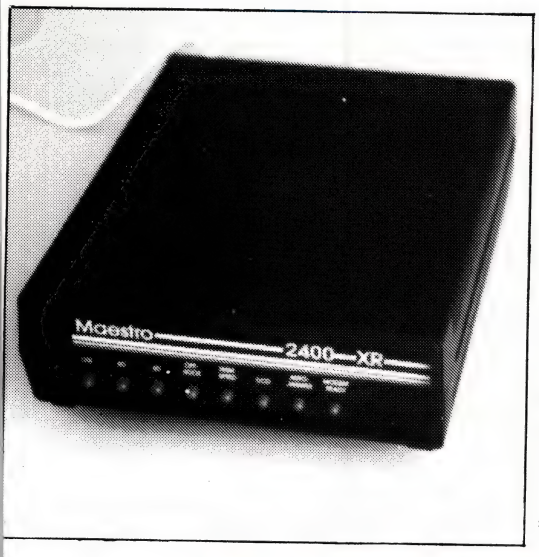
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```
HELP@1          DB      '/Mx - Set Cache Size To x KB',13,10
                DB      '/E - Use EMS',13,10
                DB      '/Hx - Cache Physical Disk x',13,10
                DB      'Defaults: /M64 /H@ /ON',13,10,'$'

HELP1           DB      'Invalid Cache Size$'
HELP2           DB      'Already Installed$'
HELP3           DB      'Invalid Command$'
HELP6           DB      'Hard Disk Too Large$'
HELP7           DB      'No EMS Memory$'
HELP8           DB      'EMS Driver Error$'
HELP9           DB      'Invalid Disk$'
HELP10          DB      'Cannot Uninstall$'

MSG1            DB      'Cache Installed',13,10,'$'
MSG2            DB      'Not Enough Memory',13,10,'$'


COMMANDS        DB      'oumhe'                 ;Letters corrsponding to the
COMMANDS_END    =       $                       ;  command line switches.

MEM_SIZE_TBL    DB      '16326412255110204081'  ;Numbers corresponding to the
MEM_SIZE_TBL_END =      $                       ;  allowable cache sizes.

JUMPTABLE:
                DW      OFFSET CACHE_ON_OFF
                DW      OFFSET UNINSTALL
                DW      OFFSET CACHE_SIZE
                DW      OFFSET DISK_SELECT
                DW      OFFSET EXPANDED_MEM


;-----------------------------------------------------------------------------
;Main. This routine performs the instalation, and modification of the cache.
;-----------------------------------------------------------------------------
MAIN            PROC
                ASSUME CS:CODE,DS:CODE,ES:CODE,SS:CODE
MAIN_ENTRY:
;-----------------------------------------------------------------------------
;display program header
;-----------------------------------------------------------------------------
                MOV     DX,OFFSET PROGRAM
                MOV     AH,9
                INT     21H
;-----------------------------------------------------------------------------
;Deallocate environment block
;-----------------------------------------------------------------------------
                PUSH    ES
                MOV     ES,ENV_SEG              ;Get the segment from the PSP
                ASSUME ES:NOTHING
                MOV     AH,49H                  ;Call dos release memory function.
                INT     21H
                POP     ES
                ASSUME ES:CODE

;-----------------------------------------------------------------------------
;check for other copies of this program in memory.
;-----------------------------------------------------------------------------
FIND_COPIES:
                XOR     BX,BX                   ;Start search a segment @
                MOV     WORD PTR [ENTRY],BX
                MOV     AX,CS                   ;Get current segment
FIND_LOOP:
                INC     BX                      ;Check next segment
                MOV     ES,BX                   ;Use es as segment pointer
                ASSUME ES:NOTHING
                CMP     AX,BX                   ;Did we find ourselves?
                JE      NO_COPIES               ;Yes, only 1 copy in memory
                MOV     SI,OFFSET ENTRY         ;SI is the offset pointer
                MOV     DI,SI                   ;Look the same place in both segs
                MOV     CX,16                   ;Check 16 bytes
                CLD                             ;Incriment pointers during compare
                REPE    CMPSB                   ;Compare bytes
                JNE     FIND_LOOP               ;If no compare, check another seg
                INC     ALRDY_IN_MEM            ;Set already installed flag


;-----------------------------------------------------------------------------
;Check for other parameters on the command line.
;-----------------------------------------------------------------------------
NO_COPIES:
                MOV     OTHER_SEG,ES            ;Save the segment of the copy
                PUSH    CS
                POP     ES
                ASSUME ES:CODE
                MOV     DI,OFFSET TAIL_LENGTH   ;Use di to point to command line
                MOV     AX,1234H                ;Set ax to 1234 to indicate if a
FIND_COMMAND:                                   ;  command was ever found.
                INC     DI
                DEC     TAIL_LENGTH             ;If we are at the end of the
                JL      FIND_COMMAND_DONE       ;  command line, exit.
                CMP     BYTE PTR [DI],'?'
                JE      DISP_HELP
                CMP     BYTE PTR [DI],'/'       ;if / found a command may
                JNE     FIND_COMMAND            ;  follow.


;-----------------------------------------------------------------------------
;Figure out what the command is, then process it if possible.
;-----------------------------------------------------------------------------
DECODE_COMMAND:
                MOV     SI,OFFSET COMMANDS      ;Use si to point to the possible
                XOR     BX,BX                   ;  command letters.
                MOV     AL,1[DI]                ;Get command from tail
                OR      AL,20H                  ;Convert uppercase to lower
DECODE_LOOP:
                CMP     AL,[SI]                 ;Search the list of allowable
                JE      COMMAND_FOUND           ;  commands.
                INC     BX                      ;If the letters don't match,
                INC     SI                      ;  inc the pointers to the cmd
                CMP     SI,OFFSET COMMANDS_END  ;If the command was not found,
                JBE     DECODE_LOOP             ;  display error message.
ILLEGAL_COMMAND:
                MOV     DX,OFFSET HELP3         ;Command unrecognised.
                JMP     SHORT HELP_ROUTINE
COMMAND_FOUND:
                CMP     BL,1                    ;Allow only on, off, and remove
                JLE     COMMAND_FOUND1          ;  if cache already installed.
                CMP     ALRDY_IN_MEM,0
                JNE     DISP_HELP2
COMMAND_FOUND1:
                SAL     BX,1                    ;Convert bx into an index into
                ADD     BX,OFFSET JUMPTABLE     ;  the jump table.
                CALL    [BX]
                JC      HELP_ROUTINE            ;If the carry flag is set on
                JMP     SHORT FIND_COMMAND      ;  return, display error message.
FIND_COMMAND_DONE:
                CMP     ALRDY_IN_MEM,0          ;If not installed, install.
                JE      INSTALL_CACHE
                CMP     AX,1234H                ;Were any commands processed?
                JE      DISP_HELP2              ;No, print already installed msg
TERMINATE:
                MOV     AX,4C00H                ;Terminate with 0 return code.
                INT     21H

;-----------------------------------------------------------------------------
;Print help lines.
;-----------------------------------------------------------------------------
DISP_HELP2:
                MOV     DX,OFFSET HELP2         ;dcache already installed
                JMP     SHORT HELP_ROUTINE
DISP_HELP6:
                MOV     DX,OFFSET HELP6         ;Disk too large
HELP_ROUTINE:
                PUSH    DX                      ;Save offset to message
                MOV     AH,2                    ;Output a carrage return
                MOV     DL,10                   ;  to put a space between
                INT     21H                     ;  the messages.
                POP     DX                      ;Get back offset.


                MOV     AH,9                    ;DOS print string routine
                INT     21H
DISP_HELP:
                MOV     DX,OFFSET HELP@         ;Display possible commands
                MOV     AH,9
                INT     21H
                CMP     ALRDY_IN_MEM,1          ;Check already installed flag
                JE      RETURN_WITH_1
                MOV     DX,OFFSET HELP@1        ;If not already installed, print


                MOV     AH,9                    ;  full list of allowable
                INT     21H                     ;  command line switches.
RETURN_WITH_1:
                MOV     AX,4C01H                ;Terminate with 1 return code.
                INT     21H
;-----------------------------------------------------------------------------
;Install routine. Compute disk parameters, reserve ems memory if needed,
;                 compute lookup table size, then jump to install1 routine.
;-----------------------------------------------------------------------------
INSTALL_CACHE:
                MOV     AH,08H                  ;Read drive parameters
                MOV     DL,DISK_NUM
                INT     13H
                JNC     GOOD_DRIVE              ;Check to insure that a valid
                MOV     DX,OFFSET HELP9         ;  disk has been selected.
                JMP     SHORT HELP_ROUTINE
GOOD_DRIVE:
                MOV     DL,DH
                XOR     DH,DH
                INC     DX
                MOV     MAX_HEAD,DX             ;save maximum head value
                MOV     AX,CX
                AND     CX,@@3FH
                MOV     MAX_SECTOR,CX           ;save maximum sector value
                XCHG    AH,AL                   ;Compute the largest logical
                ROL     AH,1                    ;  sector value. If the value is
                ROL     AH,1                    ;  larger than 19 bits, display
                AND     AX,03FFH                ;  error message and exit.
                MUL     MAX_HEAD
                ADD     AX,MAX_HEAD
                MUL     MAX_SECTOR
                ADD     AX,MAX_SECTOR
                ADC     DX,0
                CMP     DL,8
                JAE     DISP_HELP6


;-----------------------------------------------------------------------------
;Allocate memory for the cache.
;-----------------------------------------------------------------------------
                MOV     AX,ADDR_MASK            ;Compute amount of memory needed
                INC     AX                      ;  for the cache. To do this,
                INC     AX                      ;  multiply the number of entrys
                MOV     LOOKUP_SIZE,AX          ;  in the lookup table by the
                MOV     CL,PAGE_SIZE            ;  page size and the sector size.
                XOR     CH,CH
                MUL     CX
                MOV     CX,256                  ;Correct for computing twice the
                MUL     CX                      ;  number of lookup table entrys
                MOV     CX,4                    ;  by halving the sector size.
MEM_LOOP1:                                      ;Convert requested memory into
                SHR     DX,1                    ;  paragraphs.
                RCR     AX,1
                LOOP    MEM_LOOP1


;-----------------------------------------------------------------------------
;Check which memory to use.
;-----------------------------------------------------------------------------
                CMP     EMS_FLAG,1
                JNE     GET_DOS_MEM
;-----------------------------------------------------------------------------
;Request memory from EMS driver.
;-----------------------------------------------------------------------------
                MOV     CX,10
EMS_REQ_LOOP1:
                SHR     DX,1                    ;Convert paragraphs to EMS pages.
                RCR     AX,1                    ;  Each page is 16K big.
                LOOP    EMS_REQ_LOOP1
;-----------------------------------------------------------------------------
;Check to see if there is enough EMS memory to hold the cache.
;-----------------------------------------------------------------------------
                MOV     CX,AX                   ;save number of ems pages needed
                MOV     AH,42H
                INT     67H
                OR      AH,AH                   ;check for error
                JNE     EMS_ERROR
                CMP     BX,CX                   ;compare available pages with need
                JAE     GET_EMS_SEG
                JMP     MEMORY_ERROR

;-----------------------------------------------------------------------------
;Find out the segment of the EMS page frame.
;-----------------------------------------------------------------------------
GET_EMS_SEG:
                MOV     AH,41H                  ;get page frame address command
                INT     67H                     ;call EMS driver
                OR      AH,AH                   ;check for error
                JNE     EMS_ERROR
                MOV     CACHE_SEGMENT,BX        ;save page frame segment address
                MOV     MAX_SEGMENT,BX
                MOV     SIZE_MASK,0
;Request the memory from EMS driver.
                MOV     AH,43H                  ;EMS request memory function
                MOV     BX,CX                   ;put number of EMS pages in bx
                INT     67H                     ;call EMS driver
                OR      AH,AH                   ;check for error
                JNE     EMS_ERROR
                MOV     EMS_HANDLE,DX           ;save EMS handle.
                MOV     AX,ADDR_MASK            ;Create the EMS mask from the
                MOV     CL,3                    ;  addr mask
                SHR     AX,CL
                MOV     EMS_MASK,AX
;Compute the amount of resident memory needed.
```

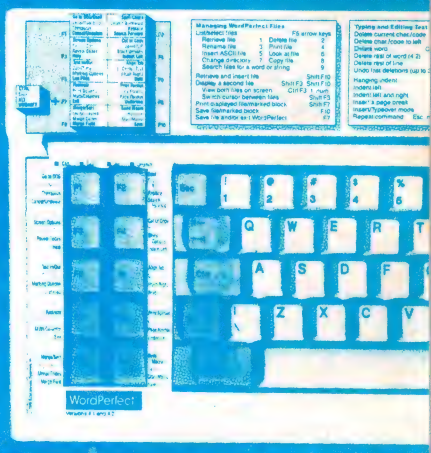
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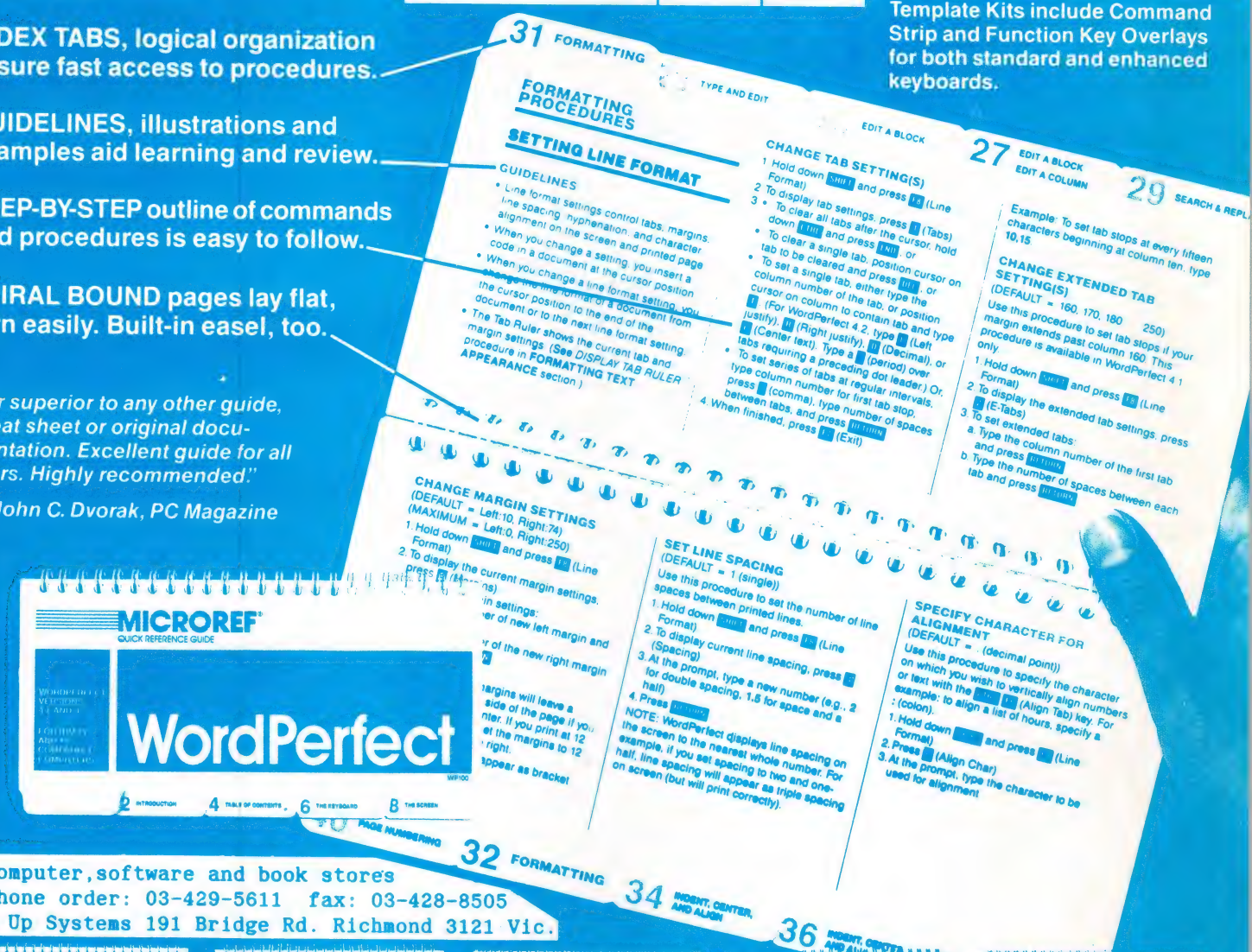
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```
                MOV     DX,LOOKUP_SIZE          ;Get back size of lookup table
                ADD     DX,OFFSET DATA_START+15
                MOV     CL,4
                SHR     DX,CL                   ;convert memory into paragraphs
                MOV     TERM_MEM,DX
                JMP     SHORT PRINT_INSTALL_MSG
;-------------------------------------------------------------------------------
;Error routines for memory requests.
;-------------------------------------------------------------------------------
EMS_ERROR:
                MOV     DX,OFFSET HELP8         ;EMS error
                JMP     HELP_ROUTINE
;-------------------------------------------------------------------------------
;Get memory from DOS. Try to reduce memory for program to see if there is
;  enough memory for the cache.
;-------------------------------------------------------------------------------
GET_DOS_MEM:
;-------------------------------------------------------------------------------
;Move the stack to a safe place inside the cache.

;-------------------------------------------------------------------------------
                CLI                             ;Inhibit interrupts during this
                MOV     BX,SP                   ;  time.
                MOV     SP,4000H                ;Move the stack pointer down
                                                ;  closer to the code, and well
                STI                             ;  with in the cache memory.
;-------------------------------------------------------------------------------
;Check size of cache memory, then reduce current allocation to minimum.
;-------------------------------------------------------------------------------
                OR      DX,DX                   ;allow cache size <= 512K
                JNE     MEMORY_ERROR            ;  for DOS memory.
                MOV     BX,OFFSET DATA_START+15 ;compute start of cache
                ADD     BX,LOOKUP_SIZE
                MOV     CL,4                    ;convert to segment.
                SAR     BX,CL
                MOV     DX,CS                   ;Get the current code segment
                ADD     DX,BX                   ;Add the converted offset
                MOV     CACHE_SEGMENT,DX        ;save the cache segment
;-------------------------------------------------------------------------------
;Continue on with allocating the proper amount of DOS memory.
;-------------------------------------------------------------------------------
                ADD     BX,AX                   ;Add size of cache.
                MOV     TERM_MEM,BX             ;reduce to amount of memory needed
                MOV     AH,4AH                  ;  at termination of the program.
                INT     21H                     ;DOS reallocate memory function
                JC      MEMORY_ERROR            ;es already points to code seg.
;-------------------------------------------------------------------------------
;Create size mask from address mask
;-------------------------------------------------------------------------------
                MOV     CX,ADDR_MASK            ;The last part of the DOS memory
                XCHG    CH,CL                   ;  installation is to create the
                SHR     CX,1                    ;  size mask needed.
                AND     CX,0FC00H               ;Create size mask from addr mask
                MOV     SIZE_MASK,CX
                MOV     AX,CACHE_SEGMENT
                ADD     AX,CX                   ;Add size mask to cache segment
                MOV     MAX_SEGMENT,AX          ; register to generate max segment

;-------------------------------------------------------------------------------
;Tell user that cache is installed.
;-------------------------------------------------------------------------------
PRINT_INSTALL_MSG:
                MOV     DX,OFFSET MSG1
                MOV     AH,9
                INT     21H
;-------------------------------------------------------------------------------
;Redirect interrupt vector 13.
;-------------------------------------------------------------------------------
                MOV     AL,ENABLED              ;save the state of the enable flag
                PUSH    AX
                MOV     ENABLED,0               ;disable cache until ready to exit
                MOV     AX,3513H                ;Get the old int 13h vector
                INT     21H
                MOV     OLD_INT13H,BX           ;Save the old vector
                MOV     OLD_INT13H[2],ES
                MOV     DX,OFFSET DISK_INT      ;Point int 13h to cache routine.
                MOV     AX,2513H
                INT     21H

;-------------------------------------------------------------------------------
;Terminate but remain resident.
;-------------------------------------------------------------------------------
                MOV     DX,TERM_MEM             ;get amount of memory needed.
                MOV     AX,3100H                ;Terminate but stay resident
                JMP     INSTALL1                ;jump to location above the
                                                ;  lookup table so it can be
                                                ;  cleared.
;-------------------------------------------------------------------------------
;Routine to print installaion error messages.
;-------------------------------------------------------------------------------
MEMORY_ERROR:
                MOV     DX,OFFSET MSG2          ;Print DOS memory error
                MOV     AH,9
                INT     21H
                MOV     AX,4C02H                ;terminate with rc = 2.
                INT     21H



;-------------------------------------------------------------------------------
;Select disk drive to cache
;-------------------------------------------------------------------------------
DISK_SELECT     PROC    NEAR
                MOV     DL,2[DI]                ;read number after /h
                SUB     DL,30h                  ;convert ascii nubmer to binary
                JL      DISK_SEL_ERR1           ;allow only the numbers 0-9.
                CMP     DL,9
                JA      DISK_SEL_ERR1
                OR      DL,80H                  ;consider only fixed disks
                MOV     DISK_NUM,DL             ;Store drive number
                CLC
                RET
DISK_SEL_ERR1:
                MOV     DX,OFFSET HELP9         ;illegal disk has been selected.
                STC
                RET
DISK_SELECT     ENDP


;-------------------------------------------------------------------------------
;Expanded memory select
;-------------------------------------------------------------------------------
EXPANDED_MEM    PROC    NEAR
;Test for the EMS driver.
                PUSH    ES
                PUSH    DI
                MOV     AX,3567H                ;Get EMS vector
                INT     21H
                MOV     DI,0AH                  ;Using the segment from the 67h
                MOV     SI,OFFSET EMS_HEADER    ;  vector, look at offset 0ah.
                MOV     CX,8                    ;  Compare the next 8 bytes with
                CLD                             ;  the expected ems header. If
                REPE    CMPSB                   ;  they are the same, allow ems
                POP     DI                      ;  option, else, print error msg.
                POP     ES                      ;Remember, poping registers does
                JNE     EMS_NOT_THERE           ;  not change the flags

;Set ems indicator.
                INC     EMS_FLAG                ;indicate EMS option
                CLC
                RET                             ;check for more commands
EMS_NOT_THERE:
                MOV     DX,OFFSET HELP7         ;display error message and exit
                STC
                RET
EXPANDED_MEM    ENDP
;-------------------------------------------------------------------------------


;Determine the size of the cache.
;-------------------------------------------------------------------------------
CACHE_SIZE      PROC    NEAR
                MOV     AX,2[DI]                ;get the number after the /m
                MOV     SI,OFFSET MEM_SIZE_TBL
                MOV     CX,2
CACHE_SIZE_LOOP1:
                CMP     AX,[SI]                 ;Search the size table to find a
                JE      SIZE_FOUND              ;  match for the size on the
                INC     CX                      ;  command line.
                ADD     SI,2
                CMP     SI,OFFSET MEM_SIZE_TBL_END
                JBE     CACHE_SIZE_LOOP1
                MOV     DX,OFFSET HELP1         ;if size unrecognised, display err
                STC
                RET
SIZE_FOUND:
                XOR     BX,BX                   ;clear register for mask gen.
CACHE_SIZE_LOOP2:
                STC                             ;shift 1's into the low bit of bx
                RCL     BX,1                    ;continue to shift 1's until the
                LOOP    CACHE_SIZE_LOOP2        ;  count id exausted.
                SAL     BX,1
                MOV     ADDR_MASK,BX
                CLC
                RET
CACHE_SIZE      ENDP

;-------------------------------------------------------------------------------
;Enable or disable the cache
;-------------------------------------------------------------------------------
CACHE_ON_OFF    PROC    NEAR
                MOV     AL,2[DI]                ;Get next letter in command line
                CMP     AL,5AH                  ;Convert uppercase to lower
                JA      ON_OFF_SKIP             ;  case if needed.
                ADD     AL,20H
ON_OFF_SKIP:
                XOR     CX,CX
                PUSH    ES
                MOV     ES,OTHER_SEG            ;Get segment of copy (if any)
                ASSUME ES:NOTHING
                CMP     AL,'f'                  ;check second letter for on or off
                JE      CACHE_OFF1
                INC     CX
                CMP     AL,'n'
                JNE     CACHE_ON_OFF_ERR
CACHE_ON1:
                CMP     ALRDY_IN_MEM,CH         ;If initial instalation, don't
                JE      CACHE_OFF1              ;  clear the lookup table here.
                CALL    RESET_CACHE
CACHE_OFF1:
                MOV     ES:ENABLED,CL           ;Set flag to enable cache
                POP     ES
                CLC
                RET
CACHE_ON_OFF_ERR:
                POP     ES
                MOV     DX,OFFSET HELP3         ;indicate an illegal command
                STC
                RET
CACHE_ON_OFF    ENDP


;-------------------------------------------------------------------------------
; UNINSTALL deallocates the memory block addressed by ES and restores the
; interrupt 13 vector displaced on installation.
;   Exit:   CF clear - program uninstalled
;           CF set   - can't uninstall
;-------------------------------------------------------------------------------
UNINSTALL       PROC    NEAR
                ASSUME DS:CODE
                PUSH    ES
                MOV     AX,3513H                ;Get int 13 vector
                INT     21H
                MOV     AX,ES                   ;Compare vector segment with
                CMP     AX,OTHER_SEG            ;  segment of installed code.
                JNE     REMOVE_ERR              ;If not the same, can't remove.
;-------------------------------------------------------------------------------
;Release the memory occupied by the program. ES already has proper segment.
;-------------------------------------------------------------------------------
                CMP     ES:EMS_FLAG,0           ;See if EMS memory or conventional
                JE      REMOVE_SKIP1
                MOV     DX,ES:EMS_HANDLE        ;If EMS memory, deallocate using
                MOV     AH,45H                  ;  function 6.
                INT     67H
                OR      AH,AH
                JNE     REMOVE_ERR
REMOVE_SKIP1:
                MOV     AH,49H                  ;DOS free memory function
                INT     21H
                JC      REMOVE_ERR              ;If carry, error on removal
;-------------------------------------------------------------------------------
;Restore interrupt 13h vector.
;-------------------------------------------------------------------------------
                PUSH    DS
                LDS     DX,ES:[OLD_DISK_INT]    ;Get old vector from installed
                MOV     AX,2513H                ;  code.
                INT     21H                     ;Set int 13 to old vector.
                POP     DS
                JC      REMOVE_ERR              ;If error, report and exit.
;-------------------------------------------------------------------------------
;Destroy the ASCII fingerprint that identifies the code and exit.
;-------------------------------------------------------------------------------
                NOT     WORD PTR ES:[ENTRY]
                CLC                             ;Clear error flag
REMOVE_EXIT:
                POP     ES
                RET
;-------------------------------------------------------------------------------
;The program can't be uninstalled.  Set CF and exit.
;-------------------------------------------------------------------------------
REMOVE_ERR:
                MOV     DX,OFFSET HELP10        ;Point to error message.
                STC                             ;Set error flag
                JMP     SHORT REMOVE_EXIT
UNINSTALL       ENDP

MAIN            ENDP
END_OF_PROG     =       $
CODE            ENDS
                END     ENTRY
```

end

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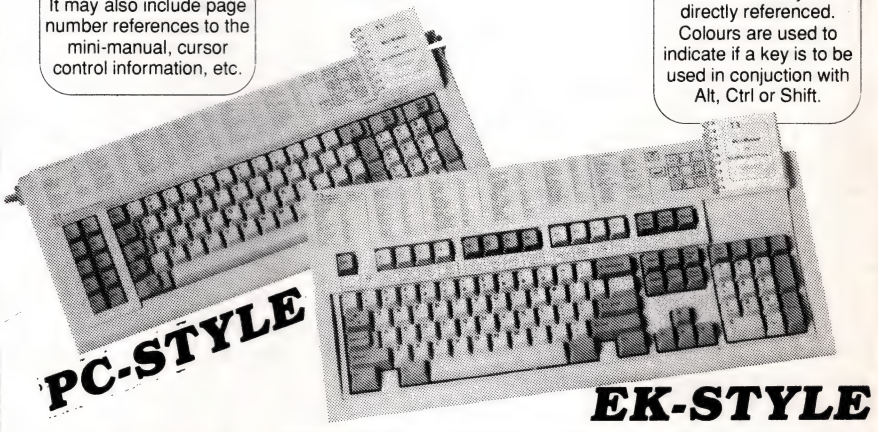
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```
100 REM - BASIC PROGRAM TO CREATE DCACHE.COM
110 CLS:PRINT "Creating DCACHE.COM  ": OPEN "DCACHE.COM  " AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM#=0
130 FOR I = 1 TO  125
140  LINESUM#=0: LOCATE 2,3: PRINT "Countdown: "  125 - I ;
150  FOR J = 1 TO  16: READ BYTE$: CHECKSUM#=CHECKSUM#+VAL("&H"+BYTE$)
160   LINESUM#=LINESUM#+VAL("&H"+BYTE$)
170   IF (BYTE < 256) THEN LSET A$=CHR$(VAL("&H"+BYTE$)): PUT #1
180  NEXT J
190  READ LINETOT$: LINECHECK# = VAL("&H"+LINETOT$)
200  IF LINECHECK# = LINESUM# THEN GOTO 220
210  LOCATE 4,2: PRINT "Error in line #"  ;  260 +  10 * I: GOTO 260
220 NEXT I
230 CLOSE: READ FILETOT$ : FILECHECK# = VAL(FILETOT$)
240 IF CHECKSUM# <> FILECHECK# THEN GOTO 260
250 PRINT: PRINT "DCACHE.COM   created successfully": SYSTEM
260 PRINT: PRINT "DCACHE.COM   is not valid!": END
270 DATA E9, EA,  4, 44, 43, 41, 43, 48, 45, 20, 31, 2E, 30, 20, 28, 63,   4C9
280 DATA 29, 20, 31, 39, 38, 38, 20, 5A, 69, 66, 66, 20, 43, 6F, 6D, 6D,   47E
290 DATA 75, 6E, 69, 63, 61, 74, 69, 6F, 6E, 73, 20, 43, 6F, 2E,  D,  A,   554
300 DATA 50, 43, 20, 4D, 61, 67, 61, 7A, 69, 6E, 65, 20, FE, 20, 44, 6F,   5D0
310 DATA 75, 67, 6C, 61, 73, 20, 42, 6F, 6C, 69, 6E, 67,  D,  A, 24, 1A,   4EC
320 DATA  1,  0,  0,  0, 1E,  0,  0,  0,  0,  0, 80,  8,  0,  0,  0,  0,   A7
330 DATA  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,   0
340 DATA  0,  0,  0,  0,  0, FF, FF, 60,  4,  0,  0,  0,  0,  0, 2E,  0,   290
350 DATA 80, 3E, 50,  1,  0, 74, 1E, 2E, 3A, 16, 5A,  1, 75, 17, FB, 80,   481
360 DATA FC,  2, 74, 16, 80, FC,  3, 74, 18, 80, FC,  1, 74,  7,  6,  E,   59F
370 DATA  7, E8, 97,  2,  7, 2E, FF, 2E, 7B,  1, 2E, 3A,  6, 5B,  1, 77,   4A7
380 DATA F4, 1E, 57, 56, 9C, 50, 53, 51, 52,  E, 1F, 89, 1E, 62,  1, 8C,   564
390 DATA  6, 64,  1, 8B, D9, 83, E3, 3F, 89, 1E, 68,  1, 88, 36, 6A,  1,   5AD
400 DATA A2, 66,  1, 88, 26, 67,  1, 86, CD, D0, C5, D0, C5, 80, E5,  3,   804
410 DATA 89,  E, 6B,  1, 8B, C1, 8A, DE, F7, 26, 5C,  1, 32, FF,  3, C3,   728
420 DATA F7, 26, 5E,  1,  3,  6, 68,  1, 83, D2,  0, 89, 16, 71,  1, A3,   4F7
430 DATA 73,  1, 8A, F8, D0, E7, 81, E3,  0, 3E, 89, 1E, 6F,  1, 80, E7,   7CD
440 DATA 30, 8B, F3, 8B, D8, B1,  5, D3, E3, 23, 1E, 56,  1,  3, 1E, 79,   6AF
450 DATA  1, 89, 1E, 6D,  1, 8B, D8, 8B, 3E, 77,  1, 80, 3E, 67,  1,  2,   4E2
460 DATA 75,  3, E9, 95,  0, 8A, C8, 80, E1,  7, 8A, 2E, 66,  1,  2, CD,   69E
470 DATA 3A,  E, 5B,  1, 77, 2A, 80, 3E, 51,  1,  0, 74,  3, E8, AB,  1,   460
480 DATA 50, E8, CF,  1, 58, 75, 59, 32, C9, 8B, 3E, 6F,  1, 8B, 36, 62,   685
490 DATA  1, 8E,  6, 6D,  1, 8E, 1E, 64,  1, FC, F3, A5,  E, 1F, EB, 40,   600
500 DATA 8B, F0, 8A,  E, 5B,  1, FE, CD, 3A, E9, 77,  2, 8A, CD, 51, E8,   866
510 DATA A1,  1, 59, 75,  4, C7,  1, FF, FF, 56, 2A, E9, 8A, D9, 32, FF,   837
520 DATA  3, F3, 80, D2,  0, 8B, C6, 5B, 33, D8, F6, C3,  8, 75, D9, 5A,   868
530 DATA 59, 5B, 58, 9D, 8E,  6, 64,  1, 5E, 5F, 1F, 2E, FF, 2E, 7B,  1,   555
540 DATA 80, 3E, 51,  1,  0, 74, E8, B4, 48, 8B, 16, 52,  1, CD, 67,  A,   59A
550 DATA E4, 74, DC, C6,  6, 50,  1,  0, EB, D5, 80, 3E, 51,  1,  0, 74,   695
560 DATA  3, E8, 27,  1, 32, C9, E8, 4A,  1, 3B,  6, 75,  1, 74, D1, 89,   5C6
570 DATA  1, A1, 73,  1, 8A, E8, 80, E5,  7,  2, 2E, 66,  1, 3A, 2E, 5B,   54E
580 DATA  1, 7E, 42, 81, FE,  0, 30, 75, 10, 8B, 16, 6D,  1, 3B, 16, 60,   4B5
590 DATA  1, 72,  6, C7,  1, FF, FF, EB, A7, 8B, 16, 71,  1, 32, FF, 8A,   79F
600 DATA 1E, 66,  1,  3, C3, 80, D2,  0, E8,  8,  1, 74, 18, 89,  1, A0,   544
610 DATA 5B,  1, 3A, C8, 75,  F, 81, C6,  0, 10, 32, E4,  1,  6, 73,  1,   4CA
620 DATA 83, 16, 71,  1,  0, 80, F9,  0, 74, 50, 32, ED, 8B, F9, 33, C9,   6E7
630 DATA 8B, 16, 71,  1, A1, 73,  1, 25, F8, FF, 75,  A,  B, D2, 75,  6,   61B
640 DATA 40, 81, C6,  0,  2, 4F, F7, 36, 5E,  1,  B, CA, 75,  5, 8B,  E,   54C
650 DATA 5E,  1, 48, 33, D2, F7, 36, 5C,  1, 8A, F2, 86, C4, D0, C8, D0,   864
660 DATA C8,  B, C8, 8B, DE, 8E,  6, 6D,  1, 8B, C7, B4,  2, 8A, 16, 5A,   708
670 DATA  1, 50, 9C, FF, 1E, 7B,  1, 5E, 72, 3F, 8B, 3E, 62,  1, 8E,  6,   555
680 DATA 64,  i, 8A, 2E, 66,  1, 32, C9, 8B, 36, 6F,  1, 8E, 1E, 6D,  1,   4CA
690 DATA FC, F3, A5,  E, 1F, 80, 3E, 51,  1,  0, 74,  F, B4, 48, 8B, 16,   5F1
700 DATA 52,  1, CD, 67,  A, E4, 74,  3, E9,  8, FF, 5A, 59, 5B, 58, 9D,   6DF
710 DATA 33, C0, 5E, 5F, 1F, F8, CA,  2,  0, A1, 73,  1, 8B, 16, 71,  1,   5BB
720 DATA 8B, 3E, 77,  1, E8, 4C,  0, C7,  1, FF, FF, 8B, CE, 3A,  E, 5B,   737
730 DATA  1, 7E,  7, 83, C3,  2, C7,  1, FF, FF, A3, 75,  1, 33, C0, 8A,   72A
740 DATA 16, 5A,  1, 9C, FF, 1E, 7B,  1, E9, B5, FE, 50, 52, B1,  5, D3,   76D
750 DATA EB, 23, 1E, 58,  1, B4, 47, 8B, 16, 52,  1, CD, 67,  A, E4, 75,   60B
760 DATA  C, B8,  0, 44, CD, 67,  A, E4, 75,  3, 5A, 58, C3, 83, C4,  6,   664
770 DATA E9, A0, FE, 25, F8, FF,  B, C2, 8B, D8, D1, EB, D1, EB, 23, 1E,   A8C
780 DATA 54,  1, 3B,  1, 74,  4,  2,  E, 5B,  1, C3, 57, 51, 50, B8, FF,   4E7
790 DATA FF, 26, 8B, 3E, 77,  1, 26, 8B,  E, 54,  1, D1, E9, 41, F3, AB,   713
800 DATA 58, 59, 5F, C3,  E,  7, E8, E2, FF, 59, 88,  E, 50,  1, CD, 21,   6DF
810 DATA  0,  0,  0,  0,  0,  0,  0, 45, 4D, 4D, 58, 58, 58, 58, 30,  D,   27C
820 DATA  A, 4F, 70, 74, 69, 6F, 6E, 73, 3A,  D,  A, 2F, 4F, 46, 46, 20,   471
830 DATA 2D, 20, 44, 69, 73, 61, 62, 6C, 65, 20, 43, 61, 63, 68, 65,  D,   502
840 DATA  A, 2F, 4F, 4E, 20, 2D, 20, 45, 6E, 61, 62, 6C, 65, 20, 43, 61,   44E
850 DATA 63, 68, 65,  D,  A, 2F, 55, 20, 2D, 20, 55, 6E, 69, 6E, 73, 74,   4B9
860 DATA 61, 6C, 6C, 20, 43, 61, 63, 68, 65,  D,  A, 24, 2F, 4D, 78, 20,   47C
870 DATA 2D, 20, 53, 65, 74, 20, 43, 61, 63, 68, 65, 20, 53, 69, 7A, 65,   528
880 DATA 20, 54, 6F, 20, 78, 20, 4B, 42,  D,  A, 2F, 45, 20, 2D, 20, 55,   375
890 DATA 73, 65, 20, 45, 4D, 53,  D,  A, 2F, 48, 78, 20, 2D, 20, 43, 61,   3F4
900 DATA 63, 68, 65, 20, 50, 68, 79, 73, 69, 63, 61, 6C, 20, 44, 69, 73,   5CD
910 DATA 6B, 20, 78,  D,  A, 44, 65, 66, 61, 75, 6C, 74, 73, 3A, 20, 2F,   4DB
920 DATA 4D, 36, 34, 20, 2F, 48, 30, 20, 2F, 4F, 4E,  D,  A, 24, 49, 6E,   35C
930 DATA 76, 61, 6C, 69, 64, 20, 43, 61, 63, 68, 65, 20, 53, 69, 7A, 65,   5BF
940 DATA 24, 41, 6C, 72, 65, 61, 64, 79, 20, 49, 6E, 73, 74, 61, 6C, 6C,   5DD
950 DATA 65, 64, 24, 49, 6E, 76, 61, 6C, 69, 64, 20, 43, 6F, 6D, 6D, 61,   5C1
960 DATA 6E, 64, 24, 48, 61, 72, 64, 20, 44, 69, 73, 6B, 20, 54, 6F, 6F,   572
970 DATA 20, 4C, 61, 72, 67, 65, 24, 4E, 6F, 20, 45, 4D, 53, 20, 4D, 65,   4C3
980 DATA 6D, 6F, 72, 79, 24, 45, 4D, 53, 20, 44, 72, 69, 76, 65, 72, 20,   57C
990 DATA 45, 72, 72, 6F, 72, 24, 49, 6E, 76, 61, 6C, 69, 64, 20, 44, 69,   5C2
1000 DATA 73, 6B, 24, 43, 61, 6E, 6E, 6F, 74, 20, 55, 6E, 69, 6E, 73, 74,   606
1010 DATA 61, 6C, 6C, 24, 43, 61, 63, 68, 65, 20, 49, 6E, 73, 74, 61, 6C,   5BC
1020 DATA 6C, 65, 64,  D,  A, 24, 4E, 6F, 74, 20, 45, 6E, 6F, 75, 67, 68,   527
1030 DATA 20, 4D, 65, 6D, 6F, 72, 79,  D,  A, 24, 6F, 75, 6D, 68, 65, 31,   523
1040 DATA 36, 33, 32, 36, 34, 31, 32, 32, 35, 35, 31, 31, 30, 32, 30, 34,   32C
1050 DATA 30, 38, 31, 59,  8, 89,  8, 2E,  8, F1,  7,  C,  8, BA,  3,  1,   38B
1060 DATA B4,  9, CD, 21,  6, 8E,  6, 2C,  0, B4, 49, CD, 21,  7, 33, DB,   571
1070 DATA 89, 1E,  0,  1, 8C, C8, 43, 8E, C3, 3B, C3, 74, 11, BE,  0,  1,   5D2
1080 DATA 8B, FE, B9, 10,  0, FC, F3, A6, 75, EC, FE,  6, 64,  4, 8C,  6,   846
1090 DATA 65,  4,  E,  7, BF, 80,  0, B8, 34, 12, 47, FE,  E, 80,  0, 7C,   50A
1100 DATA 3D, 80, 3D, 3F, 74, 5D, 80, 3D, 2F, 75, EF, BE, CA,  5, 33, DB,   6F5
1110 DATA 8A, 45,  1,  C, 20, 3A,  4, 74,  D, 43, 46, 81, FE, CF,  5, 76,   50D
1120 DATA F4, BA, 43,  5, EB, 31, 80, FB,  1, 7E,  7, 80, 3E, 64,  4,  0,   639
1130 DATA 75, 1D, D1, E3, 81, C3, E3,  5, FF, 17, 72, 1B, EB, BC, 80, 3E,   87A
1140 DATA 64,  4,  0, 74, 38, 3D, 34, 12, 74,  5, B8,  0, 4C, CD, 21, BA,   4BC
1150 DATA 31,  5, EB,  3, BA, 53,  5, 52, B4,  2, B2,  A, CD, 21, 5A, B4,   5F6
1160 DATA  9, CD, 21, BA, 6F,  4, B4,  9, CD, 21, 80, 3E, 64,  4,  1, 74,   56A
1170 DATA  7, BA, BC,  4, B4,  9, CD, 21, B8,  1, 4C, CD, 21, B4,  8, 8A,   665
1180 DATA 16, 5A,  1, CD, 13, 73,  5, BA, 86,  5, EB, CB, 8A, D6, 32, F6,   74C
1190 DATA 42, 89, 16, 5C,  1, 8B, C1, 83, E1, 3F, 89,  E, 5E,  1, 86, E0,   689
1200 DATA D0, C4, D0, C4, 25, FF,  3, F7, 26, 5C,  1,  3,  6, 5C,  1, F7,   726
1210 DATA 26, 5E,  1,  3,  6, 5E,  1, 83, D2,  0, 80, FA,  8, 73, 95, A1,   56D
1220 DATA 54,  1, 40, 40, A3, 60,  4, 8A,  E, 5B,  1, 32, ED, F7, E1, B9,   680
1230 DATA  0,  1, F7, E1, B9,  4,  0, D1, EA, D1, D8, E2, FA, 80, 3E, 51,   8E5
1240 DATA  1,  1, 75, 60, B9,  A,  0, D1, EA, D1, D8, E2, FA, 8B, C8, B4,   8E1
1250 DATA 42, CD, 67,  A, E4, 75, 47, 3B, D9, 73,  3, E9, B7,  0, B4, 41,   73F
1260 DATA CD, 67,  A, E4, 75, 38, 89, 1E, 79,  1, 89, 1E, 60,  1, C7,  6,   5C5
1270 DATA 56,  1,  0,  0, B4, 43, 8B, D9, CD, 67,  A, E4, 75, 20, 89, 16,   608
1280 DATA 52,  1, A1, 54,  1, B1,  3, D3, E8, A3, 58,  1, 8B, 16, 60,  4,   5B9
1290 DATA 81, C2, 6F,  4, B1,  4, D3, EA, 89, 16, 62,  4, EB, 48, BA, 75,   78F
1300 DATA  5, E9, 13, FF, FA, 8B, DC, BC,  0, 40, FB,  B, D2, 75, 66, BB,   8CB
1310 DATA 6F,  4,  3, 1E, 60,  4, B1,  4, D3, FB, 8C, CA,  3, D3, 89, 16,   646
1320 DATA 79,  1,  3, D8, 89, 1E, 62,  4, B4, 4A, CD, 21, 72, 47, 8B,  E,   5A0
1330 DATA 54,  1, 86, E9, D1, E9, 81, E1,  0, FC, 89,  E, 56,  1, A1, 79,   7E4
1340 DATA  1,  3, C1, A3, 60,  1, BA, A4,  5, B4,  9, CD, 21, A0, 50,  1,   5C8
1350 DATA 50, C6,  6, 50,  1,  0, B8, 13, 35, CD, 21, 89, 1E, 7B,  1, 8C,   50A
1360 DATA  6, 7D,  1, BA, 7F,  1, B8, 13, 25, CD, 21, 8B, 16, 62,  4, B8,   55B
1370 DATA  0, 31, E9, 6F, FC, BA, B6,  5, B4,  9, CD, 21, B8,  2, 4C, CD,   778
1380 DATA 21, 8A, 55,  2, 80, EA, 30, 7C,  E, 80, FA,  9, 77,  9, 80, CA,   673
1390 DATA 80, 88, 16, 5A,  1, F8, C3, BA, 86,  5, F9, C3,  6, 57, B8, 67,   7B1
1400 DATA 35, CD, 21, BF,  A,  0, BE, 67,  4, B9,  8,  0, FC, F3, A6, 5F,   6CA
1410 DATA  7, 75,  6, FE,  6, 51,  1, F8, C3, BA, 67,  5, F9, C3, 8B, 45,   745
1420 DATA  2, BE, CF,  5, B9,  2,  0, 3B,  4, 74,  F, 41, 83, C6,  2, 81,   51E
1430 DATA FE, E3,  5, 76, F2, BA, 1E,  5, F9, C3, 33, DB, F9, D1, E2, A74
1440 DATA FB, D1, E3, 89, 1E, 54,  1, F8, C3, BA, 45,  2, 3C, 5A, 77,  2,   746
1450 DATA  4, 20, 33, C9,  6, 8E,  6, 65,  4, 3C, 66, 74,  E, 41, 3C, 6E,   432
1460 DATA 75, 11, 38, 2E, 64,  4, 74,  3, E8, C0, FB, 26, 88,  E, 50,  1,   57B
1470 DATA  7, F8, C3,  7, BA, 43,  5, F9, C3,  6, B8, 13, 35, CD, 21, 8C,   707
1480 DATA C0, 3B,  6, 65,  4, 75, 31, 26, 80, 3E, 51,  1,  0, 74,  D, 26,   3ED
1490 DATA 8B, 16, 52,  1, B4, 45, CD, 67,  A, E4, 75, 1C, B4, 49, CD, 21,   6EB
1500 DATA 72, 16, 1E, 26, C5, 16, 7B,  1, B8, 13, 25, CD, 21, 1F, 72,  8,   49A
1510 DATA 26, F7, 16,  0,  1, F8,  7, C3, BA, 93,  5, F9, EB, F8,  0,  0,   724
1520 DATA 188931
```

DCACHE.BAS A Basic program that, when run once, will automatically create DCACHE.COM

page frame. DCACHE then uses interrupt 67h function 3 to see if there are enough EMS pages (each EMS page is 16k) to hold the cache. After verifying there is enough EMS memory, DCACHE reserves the memory using interrupt 67h function 4. EMS function 4 also returns a handle used by the EMS driver to refer to the owner of a page of expanded memory. The handle is stored so that it can be used by the cache routine to access the correct pages in EMS memory. The installation routine then loads the resident part of the cache routine into conventional DOS memory and terminates.

With EMS, as when using conventional DOS memory, DCACHE checks the cache directory to see if the sector requested is in the cache. (The cache directory is in conventional memory to save the time of accessing two EMS pages each time the cache is called.) If the read is a cache hit, interrupt 67h function 8 is used to save the current state of the EMS driver. DCACHE then uses interrupt 67h function 5 to map the EMS page with the correct cache page into memory. From this point on, DCACHE proceeds as if the cache were in regular DOS memory. Before returning to DOS, DCACHE uses interrupt 67h function 9 to restore the page map to the state it was in before DCACHE was called. A more detailed look at the use of expanded memory is contained in the box 'Using expanded memory'.

Performance

According to *APC*'s file access benchmark-test program, enabling DCACHE reduced the sequential read time for a file by 60 to 80 per cent. Sequential write times were lowered by between 10 and 30 per cent. Although DCACHE is a write-through cache, the savings are smaller because DOS must first read a sector before it can be written.

The time savings for random reads and writes of a file are dependent on the size of the cache. Testing with a 256k file and a record size of one sector (512 bytes) showed random read times for a 16k cache were reduced by 20 per cent; write times were reduced by five per cent. For a 64k cache, the times for random reads and writes were reduced by 40 per cent and 15 per cent, respectively. For a cache size of 256k, the random read times were reduced by 70 per cent while the random write times were reduced by 25 per cent.

The performance of DCACHE depends on how files are distributed on the disk. If the files are fragmented, DCACHE will not perform as well as if the files were tightly grouped. DCACHE performance can also be affected by the number of defective sectors on the disk. As the number of defective cylinders increases, the chances of DCACHE reading a bad sector and causing an error increases. In some cases, DCACHE may degrade the performance of file write times, though this degradation should be more than offset by the improvement in disk read times. Try it for yourself, with DCACHE turned off and on. If the feel of speed appeals to you, you'll leave it on.

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TJ'S WORKSHOP

APC's monthly pot-pourri of hardware and software productivity tips. APC will pay between $100 and $200 for each tip published. Write to TJ's Workshop, APC, 124 Castlereagh Street, Sydney 2000.

Raytrace

The program in Fig 1 is for the Atari ST and runs only in low resolution. Written in Fast Basic, it demonstrates some of the principles of ray tracing, but only uses diffuse reflection, as specular reflection would increase the length of the program and make it slower. For diffuse reflection, the intensity of the observed light is proportional to the cosine of the angle between the light 'ray' and the normal to the surface it hits.

The program takes about 30 minutes to produce a picture and this can be saved to disk in NEO format.

A large dialogue box is used to enter the co-ordinates of the light, eye and ball, and the distances are measured in pixels.

50k needs to be reserved.

D Kimberley

```
  \ RAY TRACING WITH DIFFUSE REFLECTION
  \ WRITTEN BY DAVID KIMBERLEY, MARCH 1988

  PROCinit
  PROCdialogue
  PROCset_colours
  PROCray_trace(lx%,ly%,lz%,ex%,ey%,ez%,bx%,by%,bz%,br%)
  PROCend
  END
  \ THE RAY TRACING CODE
  DEF PROCray_trace(lightx%,lighty%,lightz%,eyex%,eyey%,eyez%,ballx%,bally%,ballz%,radius%)
    LOCAL surfy%,scrz%,m,n,o,p,a,b,c,root,z0,z1,z,x,y
    LOCAL lighti,lightj,lightk,balli,ballj,ballk,modlight,modball,t,i,c%
    LOCAL divz%,surfz,divx%,surfi,surfj,surfk,modsurf
    surfy%=-100
    scrz%=0
    HIDEMOUSE
    CLG 0
\ DO EVERY SCREEN PIXEL (OFFSET TO MAKE SCREEN CENTRE 0,0)
FOR scry%=-99 TO 100
  FOR scrx%=-160 TO 159

    m=(eyex%-scrx%)/(eyez%-scrz%)
    n=(eyez%*scrx%-eyex%*scrz%)/(eyez%-scrz%)
    o=(eyey%-scry%)/(eyez%-scrz%)
    p=(eyez%*scry%-eyey%*scrz%)/(eyez%-scrz%)
    a=SQUARE(m)+SQUARE(o)+1
    b=2*(m*(n-ballx%)+o*(p-bally%)-ballz%)
    c=SQUARE(n-ballx%)+SQUARE(p-bally%)+SQUARE(ballz%)-SQUARE(radius%)
    root=SQUARE(b)-4*a*c
    \ CHECK IF EYE CAN SEE BALL
    IF root)=0 THEN
      z0=(-b+SQR(root))/(2*a)
      z1=(-b-SQR(root))/(2*a)
      IF z0)z1 THEN
        z=z0
      ELSE
        z=z1
      ENDIF
      x=m*z+n
      y=o*z+p
    ENDIF
    \ CHECK IF EYE CAN SEE BALL OR SURFACE
    IF root)=0 AND y)surfy% THEN
      \ EYE SEES BALL
      lighti=x-lightx%
      lightj=y-lighty%
      lightk=z-lightz%
      balli=x-ballx%
      ballj=y-bally%
      ballk=z-ballz%
      modlight=SQR(SQUARE(lighti)+SQUARE(lightj)+SQUARE(lightk))
      modball=SQR(SQUARE(balli)+SQUARE(ballj)+SQUARE(ballk))
      t=balli*lighti+ballj*lightj+ballk*lightk
      i=-t/(modlight*modball)
      IF i)=0 THEN
        c%=1+i*4+RND(1)
      ELSE
        c%=1
      ENDIF
      MARKCOL c%
      PLOT 160+scrx%,100-scry%
    ELSE
      \ EYE SEES SURFACE
      divz%=eyez%-scrz%
      IF divz%()0 THEN
        surfz=(scrz%*(eyey%-surfy%)+eyez%*(surfy%-scry%))/divz%
        IF surfz()0 THEN
          divx%=eyez%-scrz%
          IF divx%()0 THEN
            surfx=(scrx%*(eyez%-surfz)+eyex%*(surfz-scrz%))/divx%
            m=(lightx%-surfx)/(lightz%-surfz)
            n=(lightz%*surfx-lightx%*surfz)/(lightz%-surfz)
            o=(lighty%-surfy%)/(lightz%-surfz)
            p=(lightz%*surfy%-lighty%*surfz)/(lightz%-surfz)
            a=SQUARE(m)+SQUARE(o)+1
            b=2*(m*(n-ballx%)+o*(p-bally%)-ballz%)
            c=SQUARE(n-ballx%)+SQUARE(p-bally%)+SQUARE(ballz%)-SQUARE(radius%)
            root=SQUARE(b)-4*a*c
            \ CHECK IF LIGHT HITS BALL BEFORE SURFACE
            IF root()0 OR y(surfy%THEN
              \ LIGHT HITS SURFACE
              lighti=surfx-lightx%
              lightj=surfy%-lighty%
              lightk=surfz-lightz%
              surfi=0
              surfj=1
              surfk=0
              modlight=SQR(SQUARE(lighti)+SQUARE(lightj)+SQUARE(lightk))
              modsurf=SQR(SQUARE(surfi)+SQUARE(surfj)+SQUARE(surfk))
              t=surfi*lighti+surfj*lightj+surfk*lightk
              i=-t/(modlight*modsurf)
              IF i)=0 THEN
                c%=6+i*4+RND(1)
              ELSE
                c%=6
              ENDIF
            ELSE
              \ LIGHT HITS BALL (SHADOW)
              c%=6
            ENDIF
            \ MAKES CHEQUERED PATTERN
            cz%=surfz
            WHILE cz%(0
              cz%=cz%+80
            WEND
            cx%=surfx
            WHILE cx%(0
              cx%=cx%+80
            WEND
            c%=c%+5*((((cz% MOD 80) DIV 40)+((cx% MOD 80) DIV 40)) MOD 2)
            MARKCOL c%
            PLOT 160+scrx%,100-scry%
```

continued . . .

Fig 1 Raytrace for the Atari ST

```
          ENDIF
        ENDIF
      ENDIF
    ENDIF
  NEXT
NEXT
BEEP
\ WAITS FOR KEYPRESS
dZ=INP(2)
ENDPROC
\ DISPLAYS A DIALOG BOX AND OBTAINS COORDINATES
DEF PROCdialogue
RESERVESCREEN {OBJ_TREE+16}&,{OBJ_TREE+18}&,{OBJ_TREE+20}&,{OBJ_TREE+22}&
DRAWOBJECT OBJ_TREE,0,10,{OBJ_TREE+16}&-4,{OBJ_TREE+18}&-4,{OBJ_TREE+20}&+8,{OBJ_TREE+22}&+8
exitZ=FALSE
REPEAT
  DOFORM OBJ_TREE,-1
  MOUSE xZ,yZ,bZ,kZ
  objectZ=FINDOBJECT(OBJ_TREE,0,10,xZ,yZ)
  SWITCH objectZ
    CASE 6
      IF lxZ)-995 THEN lxZ=lxZ-5
      {nlxZ}$=STR$(lxZ)
      PROCupdate(7)
    CASE 8
      IF lxZ(995 THEN lxZ=lxZ+5
      {nlxZ}$=STR$(lxZ)
      PROCupdate(7)

    CASE 10
      IF lyZ)-995 THEN lyZ=lyZ-5
      {nlyZ}$=STR$(lyZ)
      PROCupdate(11)
    CASE 12
      IF lyZ(995 THEN lyZ=lyZ+5
      {nlyZ}$=STR$(lyZ)
      PROCupdate(11)
    CASE 14
      IF lzZ)-995 THEN lzZ=lzZ-5
      {nlzZ}$=STR$(lzZ)
      PROCupdate(15)
    CASE 16
      IF lzZ(995 THEN lzZ=lzZ+5
      {nlzZ}$=STR$(lzZ)
      PROCupdate(15)
    CASE 18
      IF exZ)-995 THEN exZ=exZ-5
      {nexZ}$=STR$(exZ)
      PROCupdate(19)
    CASE 20
      IF exZ(995 THEN exZ=exZ+5
      {nexZ}$=STR$(exZ)
      PROCupdate(19)
    CASE 22
      IF eyZ)-995 THEN eyZ=eyZ-5
      {neyZ}$=STR$(eyZ)
      PROCupdate(23)
    CASE 24
      IF eyZ(995 THEN eyZ=eyZ+5
      {neyZ}$=STR$(eyZ)
      PROCupdate(23)
    CASE 26
      IF ezZ)0 THEN ezZ=ezZ-5
      {nezZ}$=STR$(ezZ)
      PROCupdate(27)
    CASE 28
      IF ezZ(995 THEN ezZ=ezZ+5
      {nezZ}$=STR$(ezZ)
      PROCupdate(27)
    CASE 30
      IF bxZ)-995 THEN bxZ=bxZ-5
      {nbxZ}$=STR$(bxZ)
      PROCupdate(31)
    CASE 32
      IF bxZ(995 THEN bxZ=bxZ+5
      {nbxZ}$=STR$(bxZ)
      PROCupdate(31)

    CASE 34
      IF byZ)-995 THEN byZ=byZ-5
      {nbyZ}$=STR$(byZ)
      PROCupdate(35)
    CASE 36
      IF byZ(995 THEN byZ=byZ+5
      {nbyZ}$=STR$(byZ)
      PROCupdate(35)
    CASE 38
      IF bzZ)-995 THEN bzZ=bzZ-5
      {nbzZ}$=STR$(bzZ)
      PROCupdate(39)
    CASE 40
      IF bzZ(0 THEN bzZ=bzZ+5
      {nbzZ}$=STR$(bzZ)
      PROCupdate(39)
    CASE 42
      IF brZ)0 THEN brZ=brZ-5
      {nbrZ}$=STR$(brZ)
      PROCupdate(43)
    CASE 44
      IF brZ(995 THEN brZ=brZ+5
      {nbrZ}$=STR$(brZ)
      PROCupdate(43)
    CASE 45
      exitZ=TRUE
    CASE 46
      exitZ=TRUE
      lxZ=dlxZ:lyZ=dlyZ:lzZ=dlzZ
      exZ=dexZ:eyZ=deyZ:ezZ=dezZ
    ENDSWITCH
  UNTIL exitZ
ENDPROC

\ UPDATES OBJECT CHANGED BY USER IN DIALOGUE
DEF PROCupdate(objectZ)
  DRAWOBJECT OBJ_TREE,objectZ,1,{OBJ_TREE+16}&,{OBJ_TREE+18}&,{OBJ_TREE+20}&,{OBJ_TREE+22}&
ENDPROC



\ SETS UP SCREEN, INITIAL VARIABLES AND CREATES OBJ_TREE FOR DIALOGUE
DEF PROCinit
  GRAFRECT 0,0,SCREENWIDTH,SCREENHEIGHT
  TXTRECT 0,0,SCREENWIDTH,SCREENHEIGHT
  PALETTE 0,0,0,0
  PALETTE 1,1000,1000,1000

  RESERVE screen%,32768
  screen%=(screen%+512) AND $FFFF00
  LOGBASE=screen%
  PHYSBASE=screen%
  CLG 0


        G_BOX=20
        G_TEXT=21
        G_BOXTEXT=22
        G_IMAGE=23
        G_PROGDEF=24
        G_IBOX=25
        G_BUTTON=26
        G_BOXCHAR=27
        G_STRING=28
        G_FTEXT=29
        G_FBOXTEXT=30
        G_ICON=31
        G_TITLE=32

      dlxZ=-160:dlyZ=100:dlzZ=50
      dexZ=0:deyZ=50:dezZ=500
      dbxZ=-75:dbyZ=-25:dbzZ=-75:dbrZ=50

      lxZ=dlxZ:lyZ=dlyZ:lzZ=dlzZ
      exZ=dexZ:eyZ=deyZ:ezZ=dezZ
      bxZ=dbxZ:byZ=dbyZ:bzZ=dbzZ:brZ=dbrZ

      RESERVE titleZ,40
      RESERVE nameZ,40
      RESERVE lightxZ,10
      RESERVE lightyZ,10
      RESERVE lightzZ,10
      RESERVE eyexZ,10
      RESERVE eyeyZ,10
      RESERVE eyezZ,10
      RESERVE ballxZ,10
      RESERVE ballyZ,10
      RESERVE ballzZ,10
      RESERVE ballrZ,10
      RESERVE nlxZ,10
      RESERVE nlyZ,10
      RESERVE nlzZ,10
      RESERVE nexZ,10
      RESERVE neyZ,10
      RESERVE nezZ,10
```

continued . . .

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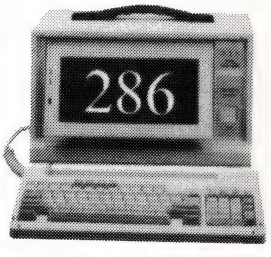
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```
  RESERVE nbx%,10
  RESERVE nby%,10
  RESERVE nbz%,10
  RESERVE nbr%,10
  RESERVE newcoords%,20
  RESERVE default%,20

  title%)$="RAY TRACING WITH DIFFUSE REFLECTION"
  name%)$="BY DAVID M KIMBERLEY 9/3/88"
  lightx%)$="LIGHT:X="
  lighty%)$="Y="
  lightz%)$="Z="
  eyex%)$="EYE  :X="
  eyey%)$="Y="
  eyez%)$="Z="
  ballx%)$="BALL :X="
  bally%)$="Y="
  ballz%)$="Z="
  ballr%)$="      R="
  nlx%)$=STR$(lx%)
  nly%)$=STR$(ly%)
  nlz%)$=STR$(lz%)
  nex%)$=STR$(ex%)
  ney%)$=STR$(ey%)
  nez%)$=STR$(ez%)
  nbx%)$=STR$(bx%)
  nby%)$=STR$(by%)
  nbz%)$=STR$(bz%)
  nbr%)$=STR$(br%)
  newcoords%)$="NEW COORDS"
  default%)$="DEFAULT COORDS"

  RESTORE object_tree_data
  READ numobjects%
  RESERVE OBJ_TREE,24*numobjects%
  FOR object%=0 TO numobjects%-1
    FOR index%=0 TO 22 STEP 2
      READ (OBJ_TREE+index%+object%*24)%
    NEXT
  NEXT
ENDPROC
\ SETS COLOURS FOR SCREEN AND FOR NEO HEADER
DEF PROCset_colours
  LOCAL i%,p%,r%,g%,b%
  FOR i%=0 TO 128 STEP 2
    (screen%-128+i%)%=0
  NEXT
  RESTORE col_data
  FOR i%=0 TO 15
    READ r%,g%,b%
    p%=(r%((8)+(g%((4)+b%
    (screen%-124+i%*2)%=p%
    SETCOL i%,r%,g%,b%
  NEXT
ENDPROC

\ CHECKS IF PICTURE TO BE SAVED AND RESETS SOME COLOURS
DEF PROCend
  GRAB 0,0,SCREENWIDTH,SCREENHEIGHT
  SHOWMOUSE
  PALETTE 1,1000,1000,1000
  alert%=ALERT(*[1][Do you want to save this?][Yes|No]",1)
  IF alert%=1 THEN PROCsave_neo
  PALETTE 0,1000,1000,1000
  PALETTE 1,0,0,0
ENDPROC
\ SAVES SCREEN IN NEO FORMAT
DEF PROCsave_neo
LOCAL p$,f$,f%

  p$=PATH$+"*.NEO"
  f%=0
  FSELECT p$,f$,f%
  IF f%=0 THEN ENDPROC
  WHILE RIGHT$(p$,1)()"\"
    p$=LEFT$(p$,LEN(p$)-1)
  WEND
  PATH$=p$
  HIDEMOUSE
  PALETTE 1,1000/7,0,0
  PUT 0,0,3
  BSAVE f$,screen%-128,32128
  SHOWMOUSE
ENDPROC

object_tree_data:

\ Number of objects
DATA 47
\ obj 0 data
DATA -1,1,4,G_BOX,0,$10,$3,$1130,10,10,300,180
\ obj 1 data
DATA 2,-1,-1,G_BUTTON,0,0,title%))16,title%,0,0,300,19
\ obj 2 data
DATA 3,-1,-1,G_STRING,0,0,name%))16,name%,45,29,217,7
\ obj 3 data
DATA 4,5,44,G_BOX,0,0,0,0,5,55,291,59
\ obj 4 data
DATA 0,45,46,G_IBOX,0,0,0,0,22,139,256,19
\ obj 5 data
DATA 6,-1,-1,G_STRING,0,0,lightx%))16,lightx%,0,1,65,10
\ obj 6 data
DATA 7,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,66,0,10,10
\ obj 7 data
DATA 8,-1,-1,G_BUTTON,0,0,nlx%))16,nlx%,77,0,33,10
\ obj 8 data
DATA 9,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,111,0,10,10
\ obj 9 data
DATA 10,-1,-1,G_STRING,0,0,lighty%))16,lighty%,130,1,19,10
\ obj 10 data
DATA 11,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,150,0,10,10
\ obj 11 data
DATA 12,-1,-1,G_BUTTON,0,0,nly%))16,nly%,161,0,33,10
\ obj 12 data
DATA 13,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,195,0,10,10
\ obj 13 data
DATA 14,-1,-1,G_STRING,0,0,lightz%))16,lightz%,214,0,19,10
\ obj 14 data
DATA 15,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,234,0,10,10
\ obj 15 data
DATA 16,-1,-1,G_BUTTON,0,0,nlz%))16,nlz%,245,0,33,10
\ obj 16 data
DATA 17,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,279,0,10,10
\ obj 17 data
DATA 18,-1,-1,G_STRING,0,0,eyex%))16,eyex%,0,16,65,10
\ obj 18 data
DATA 19,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,66,16,10,10
\ obj 19 data
DATA 20,-1,-1,G_BUTTON,0,0,nex%))16,nex%,77,16,33,10
\ obj 20 data
DATA 21,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,111,16,10,10
\ obj 21 data
DATA 22,-1,-1,G_STRING,0,0,eyey%))16,eyey%,130,16,19,10
\ obj 22 data
DATA 23,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,150,16,10,10
\ obj 23 data
DATA 24,-1,-1,G_BUTTON,0,0,ney%))16,ney%,161,16,33,10
\ obj 24 data
DATA 25,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,195,16,10,10
\ obj 25 data
DATA 26,-1,-1,G_STRING,0,0,eyez%))16,eyez%,214,16,19,10
\ obj 26 data
DATA 27,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,234,16,10,10
\ obj 27 data

DATA 28,-1,-1,G_BUTTON,0,0,nez%))16,nez%,245,16,33,10
\ obj 28 data
DATA 29,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,279,16,10,10
\ obj 29 data
DATA 30,-1,-1,G_STRING,0,0,ballx%))16,ballx%,0,32,65,10
\ obj 30 data
DATA 31,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,66,32,10,10
\ obj 31 data
DATA 32,-1,-1,G_BUTTON,0,0,nbx%))16,nbx%,77,32,33,10
\ obj 32 data
DATA 33,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,111,32,10,10
\ obj 33 data
DATA 34,-1,-1,G_STRING,0,0,bally%))16,bally%,130,32,19,10
\ obj 34 data
DATA 35,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,150,32,10,10
\ obj 35 data
DATA 36,-1,-1,G_BUTTON,0,0,nby%))16,nby%,161,32,33,10
\ obj 36 data
DATA 37,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,195,32,10,10
\ obj 37 data
DATA 38,-1,-1,G_STRING,0,0,ballz%))16,ballz%,214,32,19,10
\ obj 38 data
DATA 39,-1,-1,G_BOXCHAR,64,0,$4FF,$1130,234,32,10,10
\ obj 39 data
DATA 40,-1,-1,G_BUTTON,0,0,nbz%))16,nbz%,245,32,33,10
\ obj 40 data
DATA 41,-1,-1,G_BOXCHAR,64,0,$3FF,$1130,279,32,10,10
```

continued . . .

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```
    \ obj 41 data
    DATA 42,-1,-1,6_STRING,0,0,ballrZ))16,ballrZ,0,48,73,10
    \ obj 42 data
    DATA 43,-1,-1,6_BOXCHAR,64,0,$4FF,$1130,66,48,10,10
    \ obj 43 data
    DATA 44,-1,-1,6_BUTTON,0,0,nbrZ))16,nbrZ,77,48,33,10
    \ obj 44 data
    DATA 3,-1,-1,6_BOXCHAR,64,0,$3FF,$1130,111,48,10,10
    \ obj 45 data
    DATA 46,-1,-1,6_BUTTON,5,0,newcoordsZ))16,newcoordsZ,0,0,89,18
    \ obj 46 data
    DATA 4,-1,-1,6_BUTTON,37,0,defaultZ))16,defaultZ,134,0,121,18
    '

    col_data:

    \ col 0
    DATA 0,0,0
    \ col 2
    DATA 2,0,0
    \ col 3
    DATA 3,0,0
    \ col 6
    DATA 0,1,0
    \ col 4
    DATA 4,0,0
    \ col 7
    DATA 0,2,0
    \ col 5
    DATA 5,0,0
    \ col 8
    DATA 0,3,0
    \ col 9
    DATA 0,4,0
    \ col 10
    DATA 0,5,0
    \ col 11
    DATA 0,0,1
    \ col 14
    DATA 0,0,4
    \ col 12
    DATA 0,0,2
    \ col 15
    DATA 0,0,5
    \ col 13
    DATA 0,0,3
    \ col 1
    DATA 1,0,0
```

end

Exploding atoms

The program in Fig 2 is a simple game designed specifically to run on a PC compatible with an EGA screen. The program is written in Turbo Pascal and needs the files GRAPH.TPU and EGAVGA.BGI to be present at compile time. These files are on the Graphics/MicroCalc disk supplied with Turbo Pascal 4. The program will work under different versions of Pascal and on other machines, but will need considerable modification in the graphics routines used.

The game is played by two people on an 8 by 8 grid. Each player in turn places an atom on the grid in an attempt to remove all the other players' pieces from the board. When the limiting number of atoms in a molecule required for atomic stability is reached, the molecule explodes, firing atoms into all the adjacent grid positions. Any atoms in those invaded grid locations are turned to the exploding player's colour. If the number of atoms in the new grid locations has now past the critical value a further explosion takes place. This chain reaction continues until the grid locations reach stability again. If, during all these explosions, a player loses all their pieces, the other player is declared the winner of the game.

The number of atoms required in a location for stability varies depending on its position on the grid. A corner grid location reaches instability when two atoms are present. A location on the edge of the grid reaches instability when three atoms are present, while any other location will be stable until four atoms are present.

To move the cursor around the grid the cursor keys can be used, and the return key will place an atom in the highlighted square. The number of atoms at that location can only be added to if the atoms already there are of the same colour. It can only be taken over by the other player by exploding a molecule in

```
{Writen in  Turbo Pascal 4                                                    }
{                                                                             }
{NOTE : This program, requires the programs 'GRAPH.TPU' and 'EGAVGA.BGI' which }
{       are on the 'GRAPHICS/MICROCALC' disc surplied with Turbo Pascal 4. If }
{       converting to over languages or machines, enshore that the correct    }
{       files are Instaled.                                                   }
PROGRAM exploding_atoms;
USES Graph,Crt;                                 {Instales 'GRAPH.TPU'.        }
VAR
  gd,gm : INTEGER;
  grid  : ARRAY[1..2,1..8,1..8] OF BYTE;        {Position of pieces.          }
  name  : ARRAY[1..2] OF STRING[15];            {Number of people.            }
  piece : ARRAY[1..2] OF INTEGER;               {Number of atoms on each side.}
  print : RECORD                                {Stores the values displayed  }
            play   : BYTE;                      {on screen, so that the       }
            moves  : INTEGER;                   {display is only updated when }
            piece  : ARRAY[1..2] OF INTEGER;    {nessary.                     }
          END;
  input : CHAR;                                 {Stores pressed key.          }
  x,y   : BYTE;                                 {Stores position of cursor.   }
  moves : INTEGER;                              {Moves made in game.          }
  play  : BYTE;                                 {Current player.              }

FUNCTION number(i:LONGINT):STRING;              {Convert numbers to strings.  }
VAR
  s     : STRING[15];

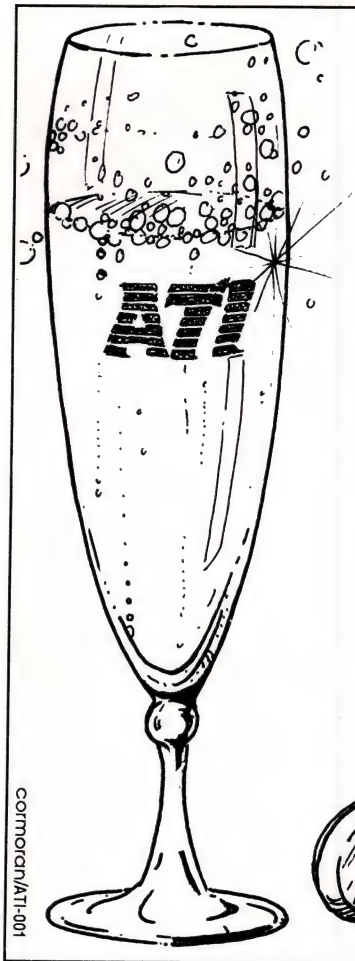
BEGIN
  STR(i,s);                                     {Converts the number 'i' to   }
  number:=s;                                    {the string 's'.              }
END;
PROCEDURE clear_view(x1,y1,x2,y2:INTEGER);      {Clears a definded area.      }
BEGIN
  SetViewPort(x1,y1,x2,y2,ClipOn);              {Set window area.             }
  ClearViewPort;                                {Clears window.               }
  SetViewPort(0,0,639,349,clipon);
END;
PROCEDURE setup;                                {Set up variables and screen. }
VAR
  loop  : INTEGER;

BEGIN
  FillChar(grid,SizeOf(grid),1);                {Sets all variables in 'grid' }
                                                {to '1'.                      }
  FillChar(piece,SizeOf(piece),0);
  FillChar(print,SizeOf(print),1);
  moves:=0;
  play:=1;
  InitGraph(gd,gm,'');                          {Instales 'EGAVGA'.           }
  ClearViewPort;                                {Clear screen (graph mode).   }
  SetColor(red);
  Rectangle(0,0,639,349);
  SetColor(blue);
  FOR loop:=1 TO 64 DO
  BEGIN
    x:=Trunc(random(8))+1;                      {Randomly picks a number      }
    y:=Trunc(random(8))+1;                      {between '0' and '9'.         }
    IF grid[1,x,y]=0 THEN
    Repeat
      INC(x);
      IF x>8 THEN
      BEGIN
        x:=1;
        INC(y);
        IF y>8 THEN y:=1;
      END;
    UNTIL grid[1,x,y]=1;
    Rectangle((x-1)*40+x+10,(y-1)*40+y+10,x*40+x+10,y*40+y+10);
    SetFillStyle(SolidFill,Cyan);               {Set up the floodfill command.}
    FloodFill((x-1)*40+x+30,(y-1)*40+y+30,Blue); {Flood area with cyan border. }
    grid[1,x,y]:=0;
    grid[2,x,y]:=0;
  END;
  SetColor(yellow);
  OutTextXY(400,75,'Player One :');             {Puts text on the screen      }
  OutTextXY(432,103,'Pieces :');                {(only in graph mode).        }
  SetColor(Magenta);
  OutTextXY(400,250,'Player Two :');
  OutTextXY(432,278,'Pieces :');
  SetColor(Green);
  OutTextXY(440,175,'Moves :');
  x:=4;
  y:=4;
END;

PROCEDURE control;                              {Controls the screen displav. }
VAR
  change : BOOLEAN;
BEGIN
  change:=FALSE;
  IF moves<>print.moves THEN
  BEGIN
    clear_view(504,175,528,182);
    SetColor(green);
    OutTextXY(504,175,number(moves));
    print.moves:=moves;
```

continued . . .

Fig 2 Exploding atoms on the IBM PC



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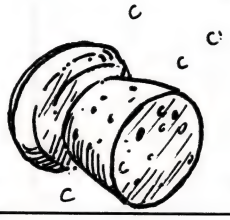
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```
  END;
  IF play<>print.play THEN
  BEGIN
    change:=TRUE;
    print.play:=play;
  END;
  IF play=1 THEN SetColor(lightred)
  ELSE SetColor(yellow);
  OutTextXY(504,75,name[1]);
  IF change OR (piece[1]<>print.piece[1]) THEN    {If the value of 'piece'
  BEGIN                                           {changes the screen will
    clear_view(504,103,528,110);                  {update the particular value.
    OutTextXY(504,103,number(piece[1]));
    print.piece[1]:=piece[1];
  END;
  IF play=1 THEN SetColor(magenta)
  ELSE SetColor(lightred);
  OutTextXY(504,250,name[2]);
  IF change OR (piece[2]<>print.piece[2]) THEN
  BEGIN
    clear_view(504,278,528,285);
    OutTextXY(504,278,number(piece[2]));
    print.piece[2]:=piece[2];
  END;
END;


PROCEDURE atom_display(x,y:INTEGER);              {Display the atoms on the
var                                               {screen.
  display : BYTE;
  color   : BYTE;

BEGIN
  SetFillStyle(SolidFill,Cyan);
  clear_view((x-1)*40+x+11,(y-1)*40+y+11,x*40+x+9,y*40+y+9);
  FloodFill((x-1)*40+x+30,(y-1)*40+y+30,Blue);
  IF play=1 THEN color:=Yellow
  ELSE color:=Magenta;
  SetColor(color);
  SetFillStyle(SolidFill,color);
  display:=grid[1,x,y];
  IF display>4 THEN display:=4;
  CASE display OF
    1 : BEGIN                                     {One atom.
          Circle((x-1)*40+x+30,(y-1)*40+y+30,7);
          FloodFill((x-1)*40+x+30,(y-1)*40+y+30,color);
        END;
    2 : BEGIN                                     {Two atoms.
          Circle((x-1)*40+x+20,(y-1)*40+y+20,7);
          FloodFill((x-1)*40+x+20,(y-1)*40+y+20,color);
          CIRCLE((x-1)*40+x+40,(y-1)*40+y+40,7);
          FloodFill((x-1)*40+x+40,(y-1)*40+y+40,color);
        END;
    3 : BEGIN                                     {Three atoms.
          CIRCLE((x-1)*40+x+20,(y-1)*40+y+20,7);
          FloodFill((x-1)*40+x+20,(y-1)*40+y+20,color);
          CIRCLE((x-1)*40+x+20,(y-1)*40+y+40,7);
          FloodFill((x-1)*40+x+20,(y-1)*40+y+40,color);
          CIRCLE((x-1)*40+x+40,(y-1)*40+y+30,7);
          FloodFill((x-1)*40+x+40,(y-1)*40+y+30,color);
        END;
    4 : BEGIN                                     {Four atoms.
          CIRCLE((x-1)*40+x+20,(y-1)*40+y+20,7);
          FloodFill((x-1)*40+x+20,(y-1)*40+y+20,color);
          CIRCLE((x-1)*40+x+20,(y-1)*40+y+40,7);


           FloodFill((x-1)*40+x+20,(y-1)*40+y+40,color);
           CIRCLE((x-1)*40+x+40,(y-1)*40+y+20,7);
           FloodFill((x-1)*40+x+40,(y-1)*40+y+20,color);
           CIRCLE((x-1)*40+x+40,(y-1)*40+y+40,7);
           FloodFill((x-1)*40+x+40,(y-1)*40+y+40,color);
         END;
  END;
END;


PROCEDURE change(a,b:BYTE);                       {Changes the property attacked
BEGIN                                             {to attackers colour.
  IF (grid[2,a,b]>0) AND (grid[2,a,b]<>play) THEN
  BEGIN
    INC(piece[play],grid[1,a,b]);                 {Adds one piece on.
    DEC(piece[grid[2,a,b]],grid[1,a,b]);          {Removes total pieces from
                                                  {other player.
  END;
  grid[2,a,b]:=play;
  INC(grid[1,a,b]);
  atom_display(a,b);                              {Displays changes on screen.
END;


PROCEDURE explode;                                {Causes atoms to explode.
var
  total   : BYTE;
  ok      : boolean;
  a,b,c,d : shortint;

BEGIN
  REPEAT
    ok:=TRUE;
    FOR a:=1 to 8 do
    FOR b:=1 to 8 do
    BEGIN
      IF grid[1,a,b]>0 THEN                       {Checks to see if explosion
                                                  {will occur.
    IF ((a=1) OR (a=8)) AND ((b=1) OR (b=8)) THEN total:=2
    ELSE IF ((a=1) OR (a=8)) OR ((b=1) OR (b=8)) THEN total:=3
    ELSE total:=4;
    IF grid[1,a,b]>=total THEN
    BEGIN
      ok:=false;
      case total OF
        2 : BEGIN                                 {Explosion on center squares.
              IF a=1 THEN c:=1 ELSE c:=-1;
              change(a+c,b);
              IF b=1 THEN c:=1 ELSE c:=-1;
              change(a,b+c);
              DEC(grid[1,a,b],2);
              atom_display(a,b);
            END;
        3 : BEGIN                                 {Explosion on edge squares.
              c:=0;
              d:=0;
              IF (a>1) AND (a<8) THEN c:=1 ELSE d:=1;
              change(a-c,b-d);
              change(a+c,b+d);
              IF c=1 THEN
              BEGIN
                IF b=1 THEN d:=1 ELSE d:=-1;
                change(a,b+d);
              END ELSE
              BEGIN
              IF a=1 THEN c:=1 ELSE c:=-1;
              change (a+c,b);
            END;
            DEC(grid[1,a,b],3);
            atom_display(a,b);
          END;
        4 : BEGIN                                 {Explosion on middle squares. }
              change(a,b-1);
              change(a,b+1);
              change(a+1,b);
              change(a-1,b);
              DEC(grid[1,a,b],4);
              atom_display(a,b);
            END;
      END;
    END;
  END;
  IF (piece[1]=0) OR (piece[2]=0) THEN ok:=TRUE;
UNTIL ok;
END;

PROCEDURE main;                                   {The main section of program.
var
  old_x : INTEGER;
  old_y : INTEGER;

BEGIN
  REPEAT
    input:=#0;
    old_x:=x;
    old_y:=y;
    SetColor(LightRed);
    Rectangle((x-1)*40+x+10,(y-1)*40+y+10,x*40+x+10,y*40+y+10);
                                                  {Lights up square where
                                                  {cursor is.
    REPEAT
    UNTIL KeyPressed;
    SetColor(blue);
    Rectangle((x-1)*40+x+10,(y-1)*40+y+10,x*40+x+10,y*40+y+10);
                                                  {Resets lighted up square.
    IF KeyPressed THEN input:=upcase(ReadKey);    {Reads in key pressed.
    CASE input OF
      #0  : CASE ord(readkey) OF
              72 : DEC(y);
              80 : INC(y);
              75 : DEC(x);
              77 : INC(x);
            END;
      #13 : BEGIN                                 {Places atom where cursor is.
              IF (grid[2,x,y]=play) OR (grid[2,x,y]=0)THEN
              BEGIN


                INC(grid[1,x,y]);
                grid[2,x,y]:=play;
                atom_display(x,y);
                INC(piece[play]);
                explode;
                INC(play);
                IF play>2 THEN
                BEGIN
                  play:=1;
                  INC(moves);
                END;
                control;
              END ELSE
              Write(#7);
            END;
    END;
    IF y<1 THEN y:=1;                             {Check cursor has not exceeded
    IF y>8 THEN y:=8;                             {limits.
    IF x<1 THEN x:=1;
    IF x>8 THEN x:=8;
  UNTIL (input='E') OR (((piece[1]=0) OR (piece[2]=0)) AND (moves>0));
END;

BEGIN                                             {The begining of the program.
  gd:=Ega;
  gm:=EgaHi;
  ClrScr;
  TextColor(blue);
  TextBackGround(black);
  GotoXY(20,11);
  Write('First Player'+char(39)+'s Name :');      {Asks for players names.
  GotoXY(19,13);
  Write('Second Player'+char(39)+'s Name :');
  TextColor(yellow);
  REPEAT
    GotoXY(42,11);
    ReadLn(name[1]);                              {Read in players names.
  UNTIL name[1]<>'';
  REPEAT
    GotoXY(42,13);
    ReadLn(name[2]);
  UNTIL name[2]<>'';
  Randomize;
  REPEAT
    setup;
    control;
    main;
    SetColor(red);
    IF input='E' THEN OutTextXY(200,325,'It is a Draw!') ELSE
    IF piece[1]=0 THEN OutTextXY(200,325,'Player Two Won!') ELSE
    IF piece[2]=0 THEN OutTextXY(200,325,'Player One Won!');
                                                  {Conclusion of game.
    SetColor(green);
    OutTextXY(150,340,'Do You Which To Replay (Y,N)');
    REPEAT
      IF KeyPressed THEN input:=UpCase(readkey);
    UNTIL (input='Y') OR (input='N');
  UNTIL input='N';                                {Restarts game is player
                                                  {presses 'Y'.
END.                                              {END.}
```

end

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an adjacent location. To exit from the game use the 'E' key. A mouse can be used if required for moving the cursor around, and it makes two-player games far simpler.

It might sound tedious on paper, but it becomes totally addictive once the art of making a chain reaction is mastered.

W Bateman

How Basic stores numbers

Several readers have been puzzled when writing a program in IBM BasicA that involves numbers larger than 32767. Entering A = 999999, for example, and listing the program shows the number changed to 999999!, with the added exclamation mark. Before I explain why an exclamation mark is always appended to large numbers, it is important to understand how numbers and numeric variables are stored by Basic internally. When you enter a program statement such as X = 132, Basic first converts the ASCII characters into a corresponding integer value before adding the statement into the program. In this case, 132 is represented by a byte with the value 132, followed by a second byte with a value of zero.

*Regardless of the number of digits that make up the number, integers are always kept in two bytes. Larger numbers are stored with the second byte holding the number of '256s' and the first byte holding the remainder. Thus, the number 258 would be represented as a 2 followed by a 1 (2 + 1*256), and the value 512 is stored as a 0 followed by a 2 (0 + 2*256).*

Of course, numbers could be kept in their ASCII form, but they would have to be converted before any calculations could be performed. This is the approach Microsoft used with some of its earlier Basic interpreters, such as the one included with the Apple II computer. Since the conversion from ASCII takes time, the designers of BasicA realised that it would be more expedient to convert the number at the time it is entered, rather than when the program runs. Further, if a program line is executed more than once, this eliminates having to perform the same conversion repeatedly.

In a similar fashion, Basic also converts its keywords to a special 'tokenised' form to save time when the program is run. For example, if you enter a Basic command such as PRINT or INPUT in a program, Basic stores them as single bytes (145 and 133, respectively). Besides saving time, this also results in a smaller program file on disk. But because Basic keywords are tokenised, they must be converted back to their original form when you list your program. This is why keywords are always displayed in uppercase — Basic has no way to know how they were originally entered.

Single-precision values are always stored in four bytes, regardless of how many digits the number contains. Double-precision variables and numbers each require eight bytes. Unless you

```
/* sfind.c
   Searches all Microsoft Word .DOC files in the default directory
       for a string.
   To compile MSC 4.0/5.0 and QuickC 1.0:  cl sfind.c
 */

#include <stdio.h>
#include <dos.h>
#include <string.h>

#define DYEAR(x) (x>>9)+80      /* These macros breakdown the calendar and */
#define DMON(x)  x>>5 & 0x000f /* time info to individual bytes */
#define DDAY(x) x & 0x001f
#define DHOUR(x) x>>11
#define DMIN(x) x>>5 & 0x003f
#define DSEC(x) x<<1 & 0x003f

#define BUFSIZE 30000               /* Program can hold a max of 30k bytes */
#define MAXFILES 500
#define WORD_HEADER_SIZE 128        /* size of Word's header in .DOC file */

struct fdir
{
    unsigned char fname[13];        /* string containing the filename */
    unsigned char attrib;           /* file attribute */
    int fhour;                      /* time */
    int fmin;
    int fsec;
    int fday;                       /* date */
    int fmon;
    int fyear;
    long fsize;                     /* size of file */
} fdata[MAXFILES];                  /* program can read up to MAXFILES files */

struct find_t ff_area;              /* defined in dos.h */

char *scompare(FILE *,char *,const char *,int);

main(int argc,char *argv[])
{
    int numfound=0;
    const char *string;         /* pointer to text to find */

    if(argc<2)
    {
        printf("Usage: SFIND <string to search>");
        exit(1);
    }
    string=strupr(argv[1]);

    if( (numfound = fsearch(string)) && numfound != -1)
        display_fileinfo(numfound,string);
    else
        printf("\n0 files found containing \"%s\"\n",string);
}

    /* fsearch()
        Allocates the search buffer.
        Finds the first .DOC file in the current directory.
        Skips past header of .DOC file.
        Calls scompare() to read the remainder of the file and search for
            the string.
        If found, puts the file information into a structure of the
            fdata array.
        Continues until all .DOC files are processed.
        Returns -1 on memory allocation error.
        Otherwise, returns the number of files found that contain the string.
    */
fsearch(const char *string)
{
    int flag;                       /*equals 0 while *.DOC files are found*/
    long loop;                      /*counts loops for files>30k*/
    int ct=0;                       /*keeps count of files found*/
    char *ffind='\0';               /*not equal to '\0' if string found*/
    FILE *ptr;                      /*pointer to FILE structure*/
    char *buffer;                   /*holds text from file*/

    if(!(buffer=(char *)malloc(BUFSIZE+1)))
    {
        printf("Memory allocation error");
        return(-1);
    }

        /* find the first file, then find all of the rest */
    for( flag=(_dos_findfirst("*.doc",_A_NORMAL,&ff_area));    !flag;
        flag = (_dos_findnext(&ff_area)))
    {
        if(!(ptr=fopen(ff_area.name,"rb")))
        {
            printf("\nsfind: unable to open %.13s\n",ff_area.name);
            continue;
        }
        printf("SEARCHING %.13s\n",ff_area.name);

                                /* skip WORD_HEADER_SIZE bytes of WORD code */
        fseek(ptr,(long)WORD_HEADER_SIZE,SEEK_SET);

                                /*if file too large for buffer */
        if((ff_area.size-WORD_HEADER_SIZE) > BUFSIZE)
        {
            for(loop = ff_area.size-WORD_HEADER_SIZE; loop && !ffind;
                loop -= BUFSIZE)
                ffind=scompare(ptr,buffer,string,BUFSIZE);
        }
        else
            ffind=scompare(ptr,buffer,string,
                (int)(ff_area.size-WORD_HEADER_SIZE));

        if(ffind)                       /*if string found...*/
        {
            strncpy(fdata[ct].fname,ff_area.name,13); /*save file data*/
            fdata[ct].attrib=ff_area.attrib;
            fdata[ct].fhour=DHOUR(ff_area.wr_time);
            fdata[ct].fmin=DMIN(ff_area.wr_time);
            fdata[ct].fsec=DSEC(ff_area.wr_time);
            fdata[ct].fday=DDAY(ff_area.wr_date);
            fdata[ct].fmon=DMON(ff_area.wr_date);
            fdata[ct].fyear=DYEAR(ff_area.wr_date);
            fdata[ct].fsize=ff_area.size;
```

continued . . .

Fig 3 SFIND searches Microsoft Word .DOC files for a single word or a string

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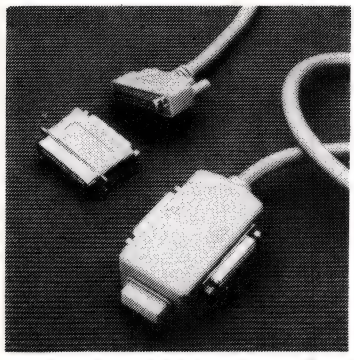
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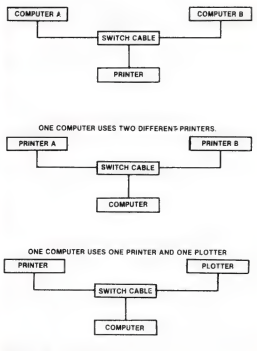
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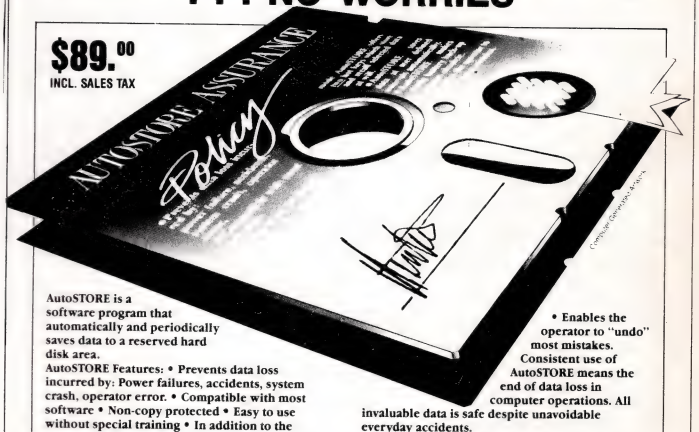


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```
            ++ct;
            if(ct == MAXFILES)
                break;
        }
        fclose(ptr);
        ffind='\0';                         /*reset to NULL*/
    }                                       /*end of FOR loop*/
    free(buffer);
    return(ct);
}

    /* display_fileinfo()
       Prints information on each file that contains the string.
     */
display_fileinfo(int numfound,char *string)
{
    int i;

    printf("\n%d file%s contain%s \"%s\":\n",
        numfound,(numfound == 1 ? "" : "s"),(numfound != 1 ? "" : "s"),
          string);
    for(i = 0; i < numfound; ++i)
        printf("%13s %7lu bytes  %02d-%02d-%02d  %02d:%02d:%02d\n",
            fdata[i].fname,
            fdata[i].fsize,
            fdata[i].fmon,
            fdata[i].fday,
            fdata[i].fyear,
            fdata[i].fhour,
            fdata[i].fmin,
            fdata[i].fsec);
}

    /* scompare()
       Reads the contents of the file pointed to by ptr. (Up to fsize bytes)
       Uppercases the buffer, to match any case.
       Searches for the string.
       Returns non-zero value if found.
       Otherwise, returns 0.
     */
char *scompare(FILE *ptr,char *buffer,const char *string,int fsize)
{
    char *ffind='\0';                   /*will not equal '\0' if string found*/
    unsigned int numread;               /*number of chars read from file*/
    const char *hold;                   /*pointer to file data to search*/

    numread=fread((char *)buffer,sizeof(char),fsize,ptr);

    if(numread)                         /*if not an empty file*/
    {
        buffer[numread] = NULL;
        hold = strupr(buffer);          /*capitalize all the characters*/
        ffind = strstr(hold,string);    /*search for string*/
    }
    return(ffind);
}
```

end

specify otherwise, Basic considers all numeric variables to be single-precision values, which brings up an important point — the 'type declaration' character.

If you want to tell Basic that a particular variable is to be double-precision, you would add a hash sign (#) after the variable's name. Integers are declared with a per cent sign, and single-precision variables use the exclamation mark. When Basic sees a statement such as X = 43, it realises that the 43 can be kept as an integer and allocates two bytes to hold it within the program. But if you were to enter X = 43.0, Basic would instead set aside four bytes and convert the number to a single-precision value. Then when the program is listed, an exclamation mark will be printed to indicate the precision. Therefore, Basic is actually doing you a favour by displaying not only the number but also its precision.

The only question that remains is why you would want to establish the precision for a numeric constant. Higher precisions can be used for variables to accommodate very large or small values, or when the accuracy of a calculation must be valid to many digits. But what does this have to do with constants?

One instance when it's important to be aware of a constant's precision is when the value is simply too large to be stored as an integer. Another is when a double-precision variable is to be assigned from an initial value that must also be very accurate. For example, if you run this short program, the resulting value of Z# will be more accurate that the variable Y#:

```
10 FOR X% = 1 TO 10000
20      Y# = Y#+1.1
30      Z# = Z#+1.1#
40 NEXT
50 PRINT Y#, Z#
```

Yet another good reason to indicate the precision of a numeric constant is to make a program run faster. Each time Basic needs to add or multiply values whose precisions are different, it must first convert one of them to the precision of the other, which takes time. Finally, FOR/NEXT loops that use an integer counter variable will also operate much more quickly, since integer math operations are much simpler than their floating-point counterparts — EW.

C search routines

Version 3.x of Microsoft Word for the IBM PC doesn't have a facility for searching files for keywords. And since my 4.0 upgrade hadn't arrived yet, I decided to write a program and solve the problem myself. SFIND.C searches Word .DOC files for keywords and strings of characters. The program is designed to be run from inside of Word via the LIBRARY/RUN function (although it can also be run from the DOS prompt) and to search all of the .DOC files in the current directory.

It doesn't handle Boolean searches with multiple arguments and it's not case sensitive, but it is fast. To use it, simply enter

```
SFIND word
```

or

```
SFIND "string to find"
```

The search string must be in quotes if it includes spaces.

L Xavier

After studying the program listing in Fig 3, you'll find that SFIND is well structured and that the work is performed by four functions (including main ()). The biggest of these functions, fsearch(), performs all of the file handling and stores any results for later display. Note that fsearch() is the only function that really has to 'know' anything about the layout of Word .DOC files.

Only a few changes have to be made to generalise SFIND enough so that it can be used to search any ASCII file. The first argument in the call to _dos_findfirst() should be changed to reflect a filespec passed on the command line. Then, remove the fseek() call and set WORD_HEADER_SIZE to 0. That's all there is to it; in fact, display_fileinfo() and scompare() can be used in other search programs without modification.

You should note the use of ANSI C function definitions in the source file; for example,

```
fsearch (const char *string)
```

instead of the following:

```
fsearch (string)
const char *string;
```

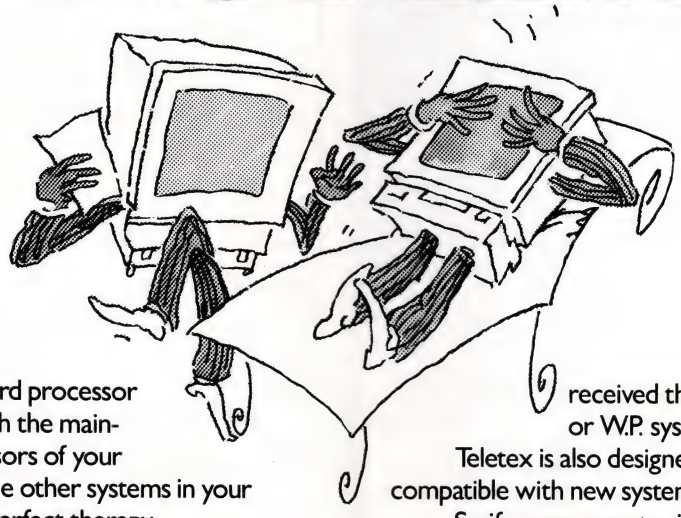
Now that ANSI C is a reality, you'll begin to see the former used much more.

There is a minor weakness in this program, however. The files are read into the buffer in BUFSIZE chunks. If the string to be found extends across the buffer (that is, part of it comes in with one chunk and the rest with another), scompare() won't find it. This will only happen on files bigger than 30k (the current setting for BUFSIZE) — RS.

Self-modifying programming

Many application programs use some form of configuration file to store internal information so they can retrieve it at a future session. For example, Microsoft

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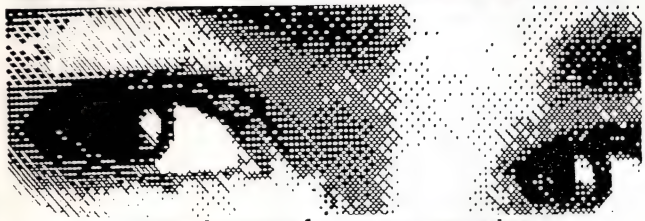
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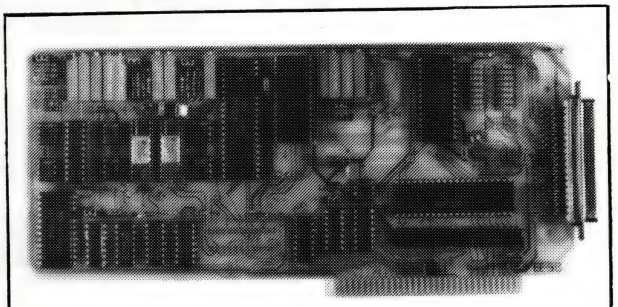
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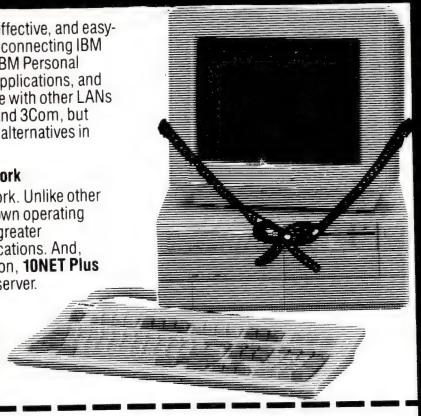
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```
PROGRAM Self_Modify;              { Compile to a .COM file before execution }

CONST
  StoredValue : STRING[80] = 'initial value of stored string';
  ProgramName : STRING[64] = 'SELFMOD.COM';

VAR
  F : FILE OF Byte;
  I : Integer;

BEGIN
  Assign(F, ProgramName);         { open .COM file }
  {$I-} Reset(F); {$I+}
  IF IOResult = 0 THEN            { check for i/o error }
    BEGIN
      {$I-} Seek(F, Ofs(StoredValue)-$100);
      {$I+}                       { get location of StoredValue }
      IF IOResult <> 0 THEN       { (a typed constant) in Cseg  }
        BEGIN
          WriteLn('Seek failed.');
          Close(F);
          Halt(1);                { abort with ErrorLevel=1 }
        END;
      WriteLn('Stored value was ->', StoredValue, '<-');
      Write('Enter new value  ->'); Read(StoredValue); WriteLn('<-');
      FOR I := Ofs(StoredValue) TO Ofs(ProgramName) DO
                                  { write new value of    }
        Write(F, Mem[CSeg:I]); { StoredValue into file }
      Close(F);
    END
  ELSE
    BEGIN
      WriteLn('Could not open file ',ProgramName);
      Halt(2);                    { abort with ErrorLevel=2 }
    END;
END.
```

Fig 4 The program listing for SELFMOD.PAS. A demonstration of how to have a program modify its own typed constants to store configuration information internally

Word stores such information in a file called MW.INI. Certain other programs such as Borland's SideKick store it within their own compiled program files.

When writing standalone applications in Turbo Pascal, it is sometimes useful to be able to use this latter technique. The Pascal program SELFMOD.PAS (shown in Fig 4) shows how simply you can do this. Note that you must not rename the program — the name of the .COM file must be identical to the name coded into the typed constant, ProgramName. Also, you must run the program from within its own subdirectory (as opposed to running it by means of a PATH).

With PC/MS-DOS version 3.x, it is possible to overcome this limitation by obtaining the full pathname of the executing program from its environment. (See TJ's Workshop, June 1987.)

C Ravindra

This is strictly a Turbo Pascal 3 technique — it works only on .COM files. But given that limitation, it does work well. If you combine this tip with the earlier ones that let you locate the exact pathname under which your program was called, you'll have a powerful method for reconfiguring your programs — NR.

Versatile copying

The DOS COPY command does not allow copying more than one set of files at a time, so I created the batch file MCOPY.BAT shown in Fig 5. Its syntax is

```
MCOPY FR:path
TO:path [fspec fspec . . .]
```

(The above command should be typed on the one line — Ed.)

The FR:path represents the source drive and directory, while the TO:path represents the destination drive and directory. Multiple filespecs are allowed, as many as can fit on the command line. Each filespec can also include wildcards.

H Tang

I like this multiple-copy technique because it illustrates an effective use of the SHIFT command. The DOS batch file facility provides a means of accessing parameters passed on the command line through nine numbered variables — namely, %1, %2, %3 . . . %9. Each of these variables corresponds to a parameter passed on the command line, working from left to right. So, for ex-

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```
ECHO OFF
REM MCOPY.BAT
IF %1.==. GOTO :ABORT
IF %2.==. GOTO :ABORT
IF %3.==. GOTO :ABORT
CD %1
SET TARGET=%2
SHIFT
SHIFT
:
:COPY
ECHO Copying %1 . . .
COPY %1 %TARGET%
SHIFT
IF %1.==. GOTO FINISH
GOTO COPY
:
:ABORT
ECHO Usage: MCOPY FR:pathspec TO:pathspec [filespec filespec...]
ECHO Example: MCOPY C:\MASM A:\MASM *.ASM *.LST *.REF
GOTO :DONE
:
:FINISH
ECHO Copy process complete
:
:DONE
SET TARGET=
```

Fig 5 MCOPY.BAT illustrates an effective use of the SHIFT command while providing the ability to copy multiple sets of files

ample, if the MCOPY batch file was executed with MCOPY A B C, the batch file variable %1 would equal A, %2 would equal B, and %3 would equal C.

This could lead you to believe that only nine parameters can be passed on the command line. Without SHIFT, that's true. But with SHIFT, the number of parameters is limited only by the maximum length of the command line (127 bytes).

The SHIFT command causes all the parameters to be shifted left by one. The value formerly assigned to %1 is lost. What used to be %2 becomes %1, %3 becomes %2, and so on (see Fig 6). So, if we execute MCOPY A B C and then SHIFT, %1 will equal B. After another SHIFT, %1 will equal C. This enables the astute batch file programmer to shift every parameter through the %1 batch file variable.

S Ricciardi

A dangerous anomaly using FASTOPEN

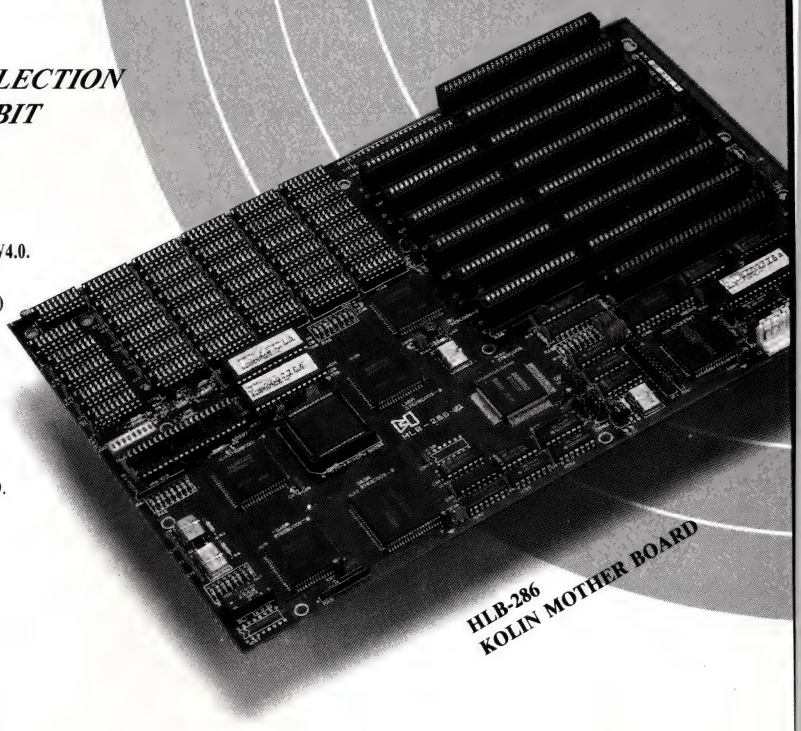
I've found that it's possible for one subdirectory to have two names at the same time. If you rename a recently referenced subdirectory while FASTOPEN is loaded, this anomaly occurs.

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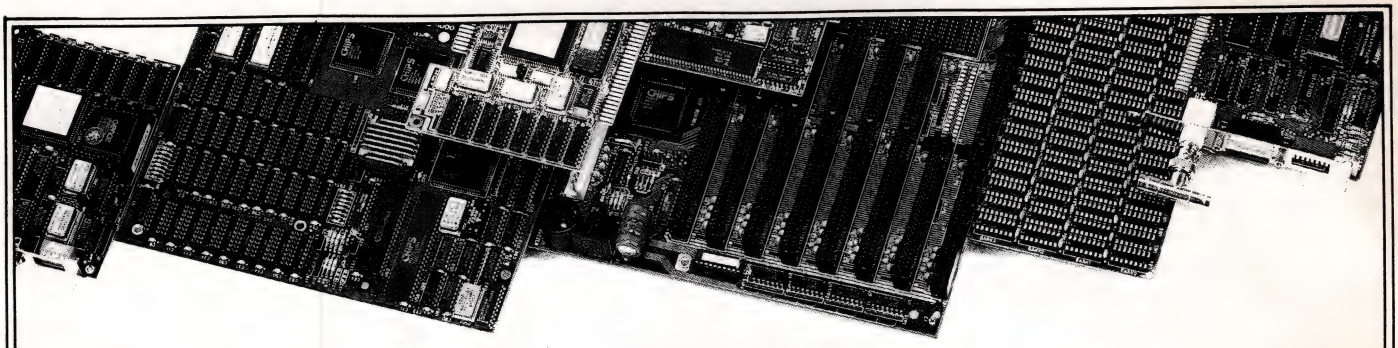


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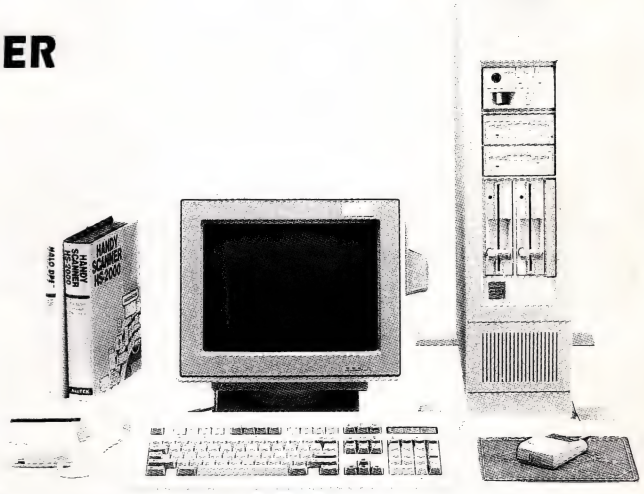
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Three things must have happened. First, you must have invoked FASTOPEN, which acts as a cache for directories. Second, you must have run a program from that subdirectory recently, so the directory's name and physical address are in the cache. Third, you must rename the directory with one of the many utilities available. *(Only some of them will cause this problem; see below — Ed.)*

The result is one physical subdirectory known by both its new name and its original name. DOS will behave as though it has two distinct subdirectories with two distinct names, but the files are shared by both. If you add a file to one directory, it will also appear in the other. If you delete a file from one, it will also be deleted from the other.

Of course, if you're not aware of this condition, it could lead to some dangerous situations. For example, noticing the duplication, you might delete all of the files in one of the directories.

J Cygman

DOS has an internal function for renaming files. Don't confuse this function with the RENAME command — RENAME uses only part of the internal function's power. Starting with DOS 3.0, the internal rename function works on subdirectories. Any utility that uses this function will work perfectly with FASTOPEN, but will not work at all with DOS 2.x.

To rename a directory under DOS 2.x, a program must bypass DOS and directly manipulate the parent directory. This behaviour is what causes the trouble with FASTOPEN. Since FASTOPEN works only with DOS 3.x, the best solution is to rename directories with utilities that are specific to DOS 3.x — NR.

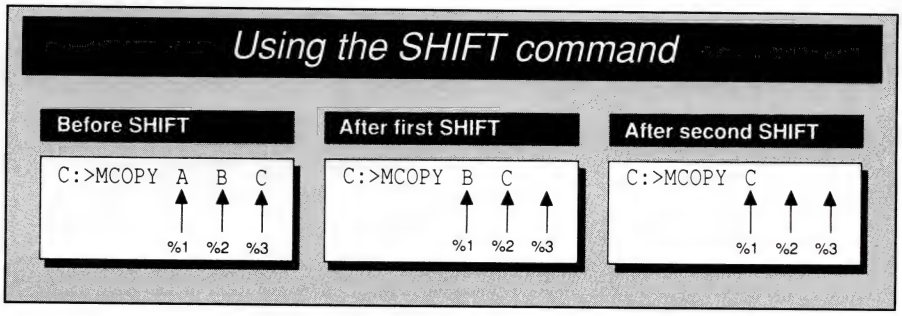


Fig 6 The diagram above illustrates the effect of the SHIFT command

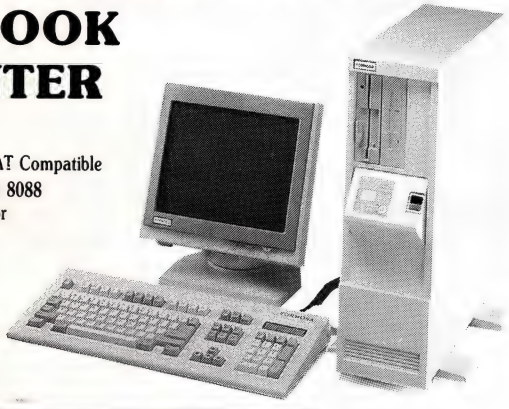
Getting better resolution from ON TIMER

The Basic ON TIMER command is very useful because it allows true multi-tasking in a Basic program. Rather than requiring the program to control when a subroutine will be executed with GOSUB or CALL, you may simply tell ON TIMER to branch to it at timed intervals. Unfortunately, the resolution of ON TIMER is limited to increments of one second, which in many cases is not fine enough.

One way around this limitation is instead to use the ON PLAY command, which can transfer control to a subroutine each time a musical note is played. If the tempo is set fast enough and the notes are very short, this can be as often as 30 or more times per second.

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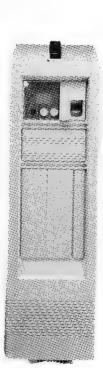
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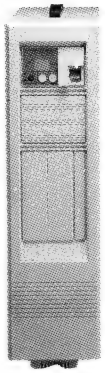
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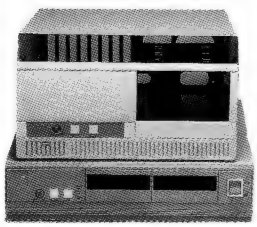






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```
DEFINT A-Z
SCREEN 2

'set up message and window location

MESSAGE$ = ".........The quick brown fox jumped over the lazy dog"
LEFT = 220
RIGHT = 420
TOP = 8
LETNUM = 0
COLUMN = 8

LINE (LEFT - 2, TOP - 2)-(RIGHT + 2, TOP + 9), 1, B 'draw box around window
DIM BUFF(2 + INT((RIGHT - LEFT + 7) / 8) * 4)       'space for buffer
DEF SEG = &HF000                                    'segment of ROM characters

'  To get a smooth crawl, we must use timed interrupts.  However,
'  ON TIMER has a minimum interval of 1 second, which is not fast enough.
'  We are forced to use ON PLAY with a song consisting of a single rest.

PLAY "MB T130 L32 N0"                       'set up "song"
ON PLAY(1) GOSUB MOVEIT                     'set up timed interrupt
PLAY ON                                     'enable timed interrupt

'  A foreground task can be executing here.  In this case, the time
'  of day is printed on the screen.

WHILE INKEY$ = ""
    LOCATE 5, 37
    PRINT TIME$
WEND
END

'  Interrupt handler for ON PLAY
'
'  MOVEIT receives control at regular intervals through the ON PLAY
'  statement.  It takes the current image in the window and shifts it
'  right one column.  It then adds a new column at the left hand edge.
'  This creates a message that "crawls" from left to right.

MOVEIT:
    GET (LEFT, TOP)-(RIGHT - 1, TOP + 7), BUFF     'get current image
    PUT (LEFT + 1, TOP), BUFF, PSET                'shift image to right

    '  A new column is added at the left.  This is constructed using the
    '  character pattern table located in ROM at F000:FA6E

    COLUMN = COLUMN + 1
    IF COLUMN = 9 THEN
       COLUMN = 1
       LETNUM = LETNUM + 1                         'start a new letter
       IF LETNUM > LEN(MESSAGE$) THEN LETNUM = 1   'wrap around if necessary

       'compute offset into pattern table for the new letter
       OFFSET = &HFA6E + ASC(MID$(MESSAGE$, LEN(MESSAGE$) - LETNUM + 1, 1)) * 8
    END IF

    'copy one column of the pattern into the left edge of the window
    FOR ROW = 0 TO 7
        BYTE = OFFSET + ROW
        BIT = (PEEK(BYTE) AND 2 ^ (COLUMN - 1))
        IF BIT = 0 THEN PRESET (LEFT, TOP + ROW) ELSE PSET (LEFT, TOP + ROW)
    NEXT

    PLAY "MB N0"                                   'create a new "song"
RETURN
```

Fig 7 A Basic example showing how ON PLAY can generate timed interrupts very quickly

The MESSAGE.BAS listing shown in Fig 7 illustrates this technique and a method for producing smooth, pixel-based scrolling. Rather than use PRINT statements, the bits for each character in the message are PEEKed from the ROM character table one column at a time.

J Parsly

Basic programmers have often used the SOUND statement to generate very short delay times, specifying a pitch that is too high to hear. However, Mr Parsly's clever use of ON PLAY provides even greater control. And, of course, SOUND cannot be used for event trapping. No music is actually played in this example because note zero is used, which in the PLAY macro command language means to pause.

If 30 times per second is too fast, the speed may be varied either by adjusting the tempo or by using notes longer than 64th notes. Notice how the PLAY command is again used inside the subroutine to prime the PLAY buffer and keep the process going. Also notice that a bug in QuickBASIC 4.0 prevents this program from working with notes that are shorter than a 32nd note in duration. In that case the PC's system clock

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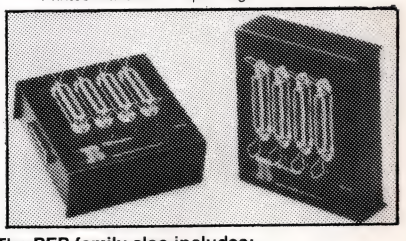
The input channels are polled sequentially until data is found on one channel. This active channel is then switched to the printer (or output channel), and the other channels are locked out. After data transfer has ceased for a period of time, sequential polling recommences.

PEPsharer has no operational controls or commands as everything is automatic.

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- There is one Status Indicator for each channel to indicating polling and the selected channel.
- All data is handled transparently by PEPsharer so graphics data may be printed without difficulty.
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- The output connector is a 25pin D type to suit a standard IBM PC printer cable.
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```
{ NOTE: This is a Turbo Pascal 4.0 program, but you can convert
  it for TP3 easily enough.  There are two places you have to
  change, both marked with "(*TP3*)".  Look for that marker and
  follow the instructions.}

{$R+}
(*TP3*)(*To use with TP3, comment out the line above and
        UN-comment out the line below*)
(* {$R+,C-} *)
PROGRAM LineDraw;
(*TP3*)(*Delete the next line for use with TP3*)
USES CRT, TURBO3;
CONST
  rows = 25;                {screen size vertically and horizontally}
  cols = 80;

VAR
  CH, CH2   : Char;         {character read from keyboard}
  screen    : ARRAY[0..26, 0..81] OF Char; {YES it is too big!}
  drawing   : Boolean;      {true while drawing}
  Erase     : Boolean;      {true while drawing and erasing}
  row, col  : Integer;      {current screen location}
  style     : Integer;      {line style -
                             0 = blank, 1 = single, 2 = double}
  holdstyle : Integer;      {hold style while erasing}

  PROCEDURE PUT(movement : Integer);
  {movement is direction of travel: 1=up, 2=right, 3=down, 4=left}

  TYPE quad = ARRAY[1..4] OF Char;

    {this array is the heart of the technique.  For each drawing
    character, it describes the connecting requirements starting at
    the top and moving clockwise around it.  Thus, vertical single
    line is 1010.}

  CONST connect : ARRAY[#179..#219] OF quad =
   ('1010', '1011', '1012', '2021', '0021', '0012',
    '2022', '2020', '0022', '2002', '2001', '1002',
    '0011', '1100', '1101', '0111', '1110', '0101',
    '1111', '1210', '2120', '2200', '0220', '2202',
    '0222', '2220', '0202', '2222', '1202', '2101',
    '0212', '0121', '2100', '1200', '0210', '0120',
    '2121', '1212', '1001', '0110', '    ');

    {default character, for impossible matches}
    line : ARRAY[0..2, 1..4] OF Char =
      ('    ', #179#196#179#196, #186#205#186#205);
    {#179  single vertical; #196  horizontal;
     #186  double vertical; #205  horizontal}

  VAR c : Char;                 {character found to display}
    hold : quad;                {pattern for character to find}

    FUNCTION check(c : Char; j : Integer): char;
    {Returns the number of lines needed to match up with the
     neighboring character C.  J is a number from 1 to 4
     representing the connecting direction}

    BEGIN
      IF (c >= #179) AND (c <= #218) THEN
        check := connect[c][j]
      ELSE check := '0';
    END;

  BEGIN
    {check all four neighbors}
    hold[1] := check(screen[row-1, col], 3); {A}
    hold[2] := check(screen[row, col+1], 4);
    hold[3] := check(screen[row+1, col], 1);
    hold[4] := check(screen[row, col-1], 2);
    hold[movement] := Chr(style+Ord('0'));
    {required pattern is built - does any character match it?}
    connect[#219] := hold;    {B}
    c := #179;
    WHILE connect[c] <> hold DO c := Succ(c);
    {If no match, use default plain line instead}
    IF c = #219 THEN c := line[style, movement];
    screen[row, col] := c;
    Write(c, ^H);
  END;

BEGIN                           {draw}
  ClrScr;
  WriteLn('Line Drawing Made Easy');
  WriteLn('Touch :');
  WriteLn;
  WriteLn(' UP');
  WriteLn(' LEFT');
  WriteLn(' RIGHT');
  WriteLn(' DOWN');
  WriteLn(' 7 - START / STOP ERASING');
  WriteLn(' 8 - SWITCH LINE STYLE TO OPPOSITE TYPE');
  WriteLn(' 9 - START / STOP DRAWING');
  WriteLn(' Esc - EXIT');
  WriteLn;
  WriteLn('Touch <Enter> to begin');
  ReadLn;
  ClrScr;
  drawing := True;
  Erase := False;
  ClrScr;
  FillChar(screen, SizeOf(screen), ' ');
  row := 12;
  col := 40;
  style := 1;
  REPEAT
    GoToXY(col, row);
    Read(Kbd, CH);
    IF (CH = #27) AND KeyPressed THEN Read(Kbd, CH2)
    ELSE CH2 := #0;
    CH := UpCase(CH);
    IF drawing THEN
      CASE CH OF
        #27 : CASE CH2 OF
                'H' : IF row > 1 THEN BEGIN put(1); row := row-1; END;
                'P' : IF row < rows THEN BEGIN put(3); row := row+1; END;
                'M' : IF col < cols THEN BEGIN put(2); col := col+1; END;
                'K' : IF col > 1 THEN BEGIN put(4); col := col-1; END;
              END;              {case CH2}
        '9' : BEGIN
                IF Erase THEN
                  BEGIN
                    style := holdstyle;
                    Erase := False;
                  END;
                drawing := False;
              END;
        '8' : IF NOT Erase THEN style := style MOD 2+1
              ELSE Write(#7);
        '7' : IF style <> 0 THEN
                BEGIN
                  holdstyle := style;
                  style := 0;
                  Erase := True;
                END
              ELSE
                BEGIN
                  style := holdstyle;
                  Erase := False;
                END;
      END {CASE CH}
    ELSE
      CASE CH OF
        #27 : CASE CH2 OF
                'H' : IF row > 1 THEN row := row-1;
                'P' : IF row < rows THEN row := row+1;
                'M' : IF col < cols THEN col := col+1;
                'K' : IF col > 1 THEN col := col-1;
              END; {case CH2}
        '9' : drawing := True;
      END; {CASE CH}
  UNTIL (CH = #27) AND (CH2 = #0);
END.                            {draw}
```

Fig 8 LINEDRAW.PAS illustrates a method for using the extended character set to draw lines on the screen

freezes, and the time does not advance — EW.

Clever lines in Turbo Pascal

When I first wrote a screen builder program, I just used the function keys to display the line-drawing characters in the PC's extended character set. This had three undesirable side effects. First, the rest of the user interface was very awkward. I had to use Alt-letter sequences, since I needed all of the Ctrl and function-key sequences for characters. Second, in practice, it was hard to remember how to turn corners and make intersections. Third, it hurt my ego every time I sat down to a good word-processing program with a proper line-drawing routine.

Fig 8 illustrates one way to use the extended character set to draw lines on the screen. The program is strongly table driven. The array 'connect' contains most of the intelligence about the character set. Each element of the table corresponds to one of the available line characters. The entry describes its appendages — top, right, bottom, left. The corresponding position in the entry encodes the style of line in each section. The styles are 0, no line; 1, single line; 2, double line.

The program constructs an image of the character it needs by checking all four neighbours at the new location and the direction of movement. It then searches in the array 'connect' for this pat-

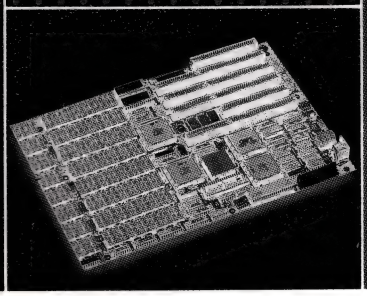
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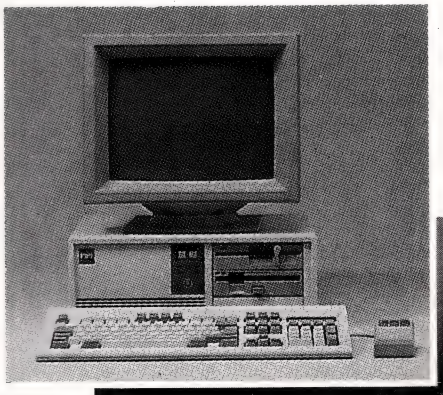
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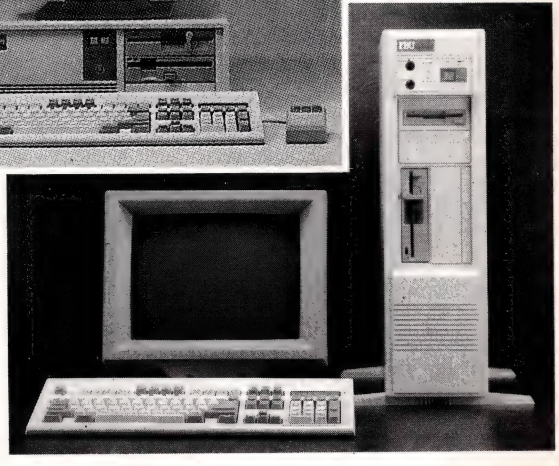
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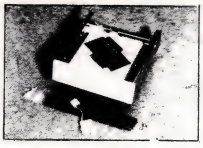
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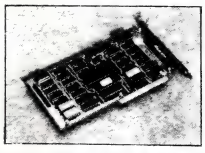
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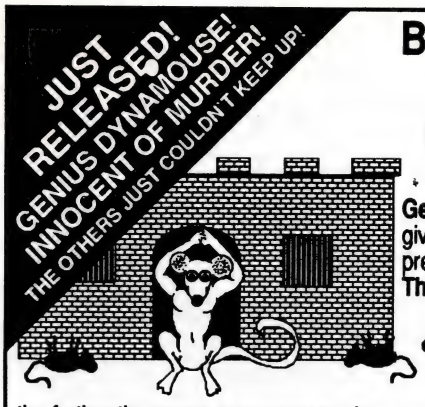
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Interface	RS-232	RS-232	PS-2 Port	PS-2 Port
Resolution DPI	200-800	350-1050	350-1050	350-1050
Button	3	3	2	2
Menu Maker	Yes	Yes	Yes	Yes
Menu Library	Yes	Yes	Yes	Yes
Dr Halo III	Yes	Yes	Yes	Yes
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Standard file handles

File handle	Usage (default assignment)
0	Standard input (CON: — keyboard)
1	Standard output (CON: — screen)
2	Standard error (CON: — screen)
3	Standard auxiliary (AUX: or COM1:)
4	Standard printer (PRN: or LPT1:)

Fig 9 The five standard devices and their default file handles

tern. If it finds the pattern, it uses the corresponding character. If not, it uses a default character.

Notice that at {A} the four calls to function 'check' build a possible character description for the next character to draw. At {B} the program searches the table for a match. It puts the item being sought as the last entry to guarantee that the search will end. If it reaches that last item without another match, the required character doesn't exist, and it substitutes a default character.

The character depends on the line style, the neighbouring characters, and the direction of movement. The program cannot write it until the cursor moves out of the screen location.

This is not so strange, since a pencil doesn't write until it moves off the spot it is sitting on. If a line is about to meet another and you wish to cross it, move ahead and you will get the correct crossing character. If you wish to end it on the other line, you must move in the direction of the other line. You will then get a T. To make a corner with a line, move up to the end of the line and move in its direction. You will get the desired corner. If you continue moving straight ahead, you will get a T-connection.

A Christoph

At first glance, it might appear that this program is writing directly to the PC's video RAM. It's fast enough to suggest that. But actually it's putting characters to the display with a simple Write statement and keeping a separate map of the display in the array 'screen'. I drew quite a tangled mess on the screen, and LINEDRAW handled it all — NR.

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Dark Castle

Here's an interesting bit of trivia concerning the Macintosh game Dark Castle. The Black Knight isn't such a mean fellow after all. Use the Alarm Clock DA or the Control Panel to set the date to December 25, then start up the game. It appears that the Knight isn't as much of a Scrooge as you might have thought (see Fig 10).

K Junck

HyperCard stash

When you're authoring HyperCard stacks on a Mac SE, you don't always have a convenient spot to stash the tools menu. You can hit the Tab key to go from button or field mode to browse mode, but this has the sometimes undesirable side effect of selecting the first unlocked field. The contents of fields can be lost this way. This can be avoided by adding the top group of lines in the illustration to the Home Stack.

And if you have the extended keyboard, you can change tools by using the function keys. Put the second group of lines from the illustration into the Home Stack:

Don't use F1 through F4, since these are reserved for Undo/Cut/Copy/Paste.

E Promislow

Mac SuperPaint

It's possible to enlarge any selection in SuperPaint to page size or any size that you want. First, use the lasso or marquee tool to select the picture. Then, use Command-C to Copy, and press Command-A to select the screen. Next, press Command-V to paste and, after a few seconds, the selection fills the entire screen. If you want a smaller enlargement instead of Command-A, use the marquee to select the size, then press Command-V.

This helps a lot when you want an enlargement, because you can choose the size first instead of slowly enlarging step by step.

S Lee

ThunderScan 2.0/4.0

Frustrated that neither version 2.0 nor 4.0 of ThunderScan will operate in the background with MultiFinder? Simply launch version 1.1x of ResEdit, locate your copy of the ThunderScan software that you want to use for a background scan, and double-click on it to open. Locate the SIZE resource, double-click on it, then locate the 0 listing in the SIZE resource. Open this by double-clicking, at which time you should see the words 'Can Background' with two radio buttons to the side. Click on the 1, and then close the file and save changes. You can now run ThunderScan in the background with MultiFinder.

You can also make most programs MultiFinder compatible, if they aren't already, by clicking on the 'Juggler Aware' button in the SIZE resource just above the 'Can Background' radio button. As an example, Picture Base can be adapted to MultiFinder in this way, so long as it is the first application opened under MultiFinder.

R Larsen



Fig 10 'Deck the halls . . .' It's Christmas at the Castle of the evil Black Knight. Turns out that the brute is just an old softie

ImageWriter

ImageWriter LQ ribbons are pricey at $37 each. Notice that only the top edge, approximately 3/8 of an inch, receives the brunt of the printing load. To double the life, simply invert the ribbon in six easy steps:

1. Remove ribbon from printer. Then remove the ribbon clip-in guide (illustration on page 12 of the owner's manual) from the ribbon by gently spreading the guide's frame and releasing the white rollers from the guide. Take slack out of the ribbon with the ribbon knob.

2. Remove the top cover of the ribbon case by releasing the tabs around its perimeter. No more than gently prying with a fingernail is necessary to accomplish cover removal. You will find heaps of accordioned ribbon inside.

3. Place the bottom of the case with the ribbon inside on a large flat surface. Release the ribbon at the knob end by pushing the lever near the knob to the side; this pulls apart the knob rollers so the ribbon can be lifted out of the knob mechanism. Release the ribbon at the other end of the case by pushing the flat metal spring to the side. Just 'let be' the short length of ribbon that is outside the case until you have inverted the 'accordion' inside the case.

4. Now poke your fingers in the case and compress the ribbon into a size that you can contain with your fingers (use both hands so you can invert the ribbon with wrist action). Lift the ribbon out of the case, invert and put is back in the case without letting go.

5. Rethread the ribbon through the knob roller and spring at the ends of the case. Take up slack with the knob roller and, as you do, the portion of the ribbon that was left dangling outside the case earlier will invert itself. Once the slack has been taken up, continue turning the roller and checking for tangles until the entire length of the ribbon has been cycled through.

6. Re-install the case cover and the ribbon guide. Pop it back in the LQ.

The whole process takes about 15 minutes.

E Sharp

A neater Finder

Want to neaten the appearance of the application and document icons inhabiting windows in the Finder?

Open the window you want to tidy up. Go to the View menu and set it so that the window is showing your applications and documents by Name and not Icon or Small Icon.

Use the Select All command under the Edit menu. Drag everything out onto the Desktop and wait a second or two while the Finder catches up with you. Go back to the View menu and reselect By Icon or By Small Icon — whichever you prefer. Then go to the File menu and select Put Away. Your applications and documents will begin quickly arranging themselves in the window in alphabetical order.

B Ferguson

Faster mouse selection

The mouse button on the Macintosh is buffered (at least on the Macintosh Plus and SE). So, when I need to open an application directly on one of my hard disks, I just make sure that all the images of the folders and the application's icon are aligned.

Let's say that you have a folder on your desktop called 'Word Prgs', inside of which are several folders containing various word processors and associated files (like 'Help' and 'Dictionary' files). The

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odds are that there is one application you'll use more than the others, such as Word 3.01, which is in a folder by the same name. Click open the Word Pgms folder, and align the newly opened window so that the Word 3.01 folder is directly over the outline of the Word Pgms folder. (This might take a few tries.)

Once they are aligned, open up the folder called Word 3.01 and align the application Word 3.01 in that window with the previous windows.

Now when you want to open your most used word-processing application, all you have to do is place the arrow cursor in the middle of the Word Pgms folder and click six times to open the two folders and launch the application.

No more moving the mouse around each time a folder window is opened to get the next folder to open. And this trick still allows you to keep a neat desktop with everything in its correct folder.

C Pearce

PageMaker

For those who do not have PageMaker 3.0 (or are waiting for their copy), printing with 2.0 to a new generation LaserWriter can be rather trying. Trying to print, for example, to the LaserWriter II/NT results in an alert box informing you to change the printer type. There's a fairly straightforward way around all of this.

Locate the LaserWriter Plus.apd file that came with PageMaker 2.0. This is the file that tells PageMaker what the printer looks like. Open this file as text, using your favourite word processor. You'll see something like the illustrated screen in Fig 11.

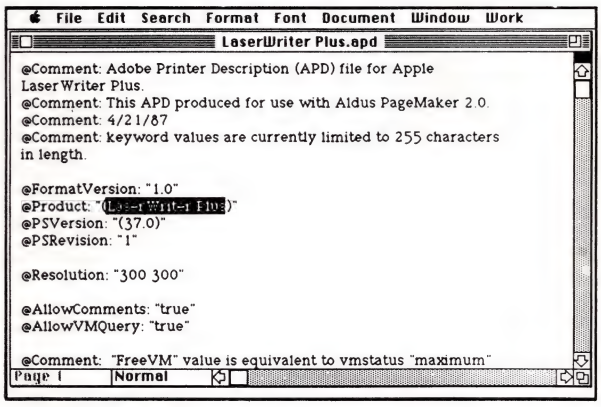


Fig 11 The top lines of the LaserWriter Plus.apd file for PageMaker 2.0a. Modifying it makes it possible to print to one of the new Apple LaserWriters without upgrading to version 3.0

Notice the highlighted section. This is the name that you'll have to change. For the LaserWriter II/NT, type in LaserWriter II NT. Make sure that you type the new name exactly as it appears in the PageMaker alert box when the program first balks at printing your file. If your printer has added capabilities (for example, a newer version PostScript or a higher resolution) make those changes as well. Note that for the LaserWriter II/NT, you can and should also change the PostScript version number in the .apd file from 37.0 to 47.0 to give marked performance increases. Do not forget to use Save As to save your file in *text format* and to use <Printer>.apd as a filename, where <Printer> is the name of the printer. The name you give to this file will show up in the Change dialogue box that you get from pressing the Change button in the Print dialogue box.

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Saving time with Autodial

In July we described Callbox, a product from the UK that turns a PC into a smart phone book that will even dial numbers for you. This month, Steve Withers looks at a locally designed and manufactured product — AutoDial.

AutoDial is neatly packaged in a box superficially resembling the slipcases that contain many MS-DOS manuals, although it is a little larger. The box contains the necessary cables, a plug pack, software (5.25in and 3.5in diskettes), a slim manual, and the AutoDial unit itself.

The presentation is good throughout, with attention to detail that helps give purchasers a sense of confidence. The AutoDial hardware is encased in a grey plastic box, with no switches to worry about, just a single LED on the front panel to show when the power is connected. The case is roughly 13cm square, and about 4cm high.

The connectors and cables are labelled, and the setting up instructions are very clear. The hardest part of the operation could be the identification of the serial port on the back of the computer. The PC to AutoDial cable actually has three connectors, catering for systems with DB25 or DB9 plugs.

Enough on the hardware — what does the software do for you? Basically, it stores and retrieves phone numbers and related information (addresses, fax and telex numbers and e-mail addresses). You can give AutoDial the name of a person or company, and it will find the phone number and optionally dial it for you. If you are writing a letter instead of phoning, AutoDial will print an address label.

While AutoDial is also able to print the full contents of the selected record, the usefulness of this function is greatly enhanced by the ability to turn the lower part of the page into a customised form. The manual suggests an order form or a salesperson's call sheet, but people in different jobs will find their own uses. How about an interview record when looking for someone to fill a job vacancy?

As well as printing individual records, you can produce lists, optionally limiting the report to a particular range of records (eg. all the Joneses). The simple selection criteria are name, company, suburb and postcode. For more detailed searching you must make use of the classification field. This is 24 characters long, and may be used to implement whatever classification scheme seems suitable for the application. If you were storing a list of bulletin boards, you might classify them in terms of modem speed, whether or not they operate 24 hours a day, and for which type of interests they cater. AutoDial could then give you a list of boards that run at 2400bps, are open 24 hours and offer MS-DOS software.

The limitation is that AND is the only available logical operation. You couldn't get a list that shows all systems except those offering online games. However you search and select the records, the resulting lists can comprise names and numbers, address labels, or full records.

Naturally, AutoDial lets you add and edit entries. The program is smart enough to check for duplicate entries when you type in a name, but it realises that names aren't unique, so if you insist on continuing it will let you. Often, successive entries in this type of application have something in common — perhaps you've just made three new contacts at a company. AutoDial turns the F6 key into a 'ditto' key, which copies information into the current field from the previous record.

All the above functions are provided by the main AutoDial program. If that's all there was, it wouldn't be much use — would you want to quit from any other program to make a phone call? Of course not, and that's why PopDial is also included. PopDial is a terminate and stay resident program that implements the search and dial functions of AutoDial. Once it is loaded, pressing Alt-A pops up the search menu.

If you already have a database that includes phone numbers, you don't have to re-enter them all into AutoDial. PopDial has a section function called QuickDial, which can read a phone number from a designated position on the screen and dial it for you with just three keystrokes.

AutoDial generally compares well with

Callbox. Whether it is better to take up one of the slots in a PC or tie up the serial port is largely a question of how your system is configured. Callbox scores with its note-taking feature and the ability to keep a costed call log, but 'hands-free' dialling is, in my personal (but very strong) opinion, a misfeature. Anyone using it can have little or no sympathy for their colleagues, and so I would congratulate AutoDial's designer for leaving it out of the package. AutoDial's manual also scores with its clarity and generous use of screen shots, and its brevity makes an index largely unnecessary.

END

AutoDial costs $399 and is available from Brylar, tel: (02) 787 4991.

System news

It seems that the Australian FidoNet is in a state of flux. I am told that a small number of users were flooding the net with junk messages, and (naturally) most sysops objected. They wanted to remove the offending board from the net, but were prevented from doing so by the way FidoNet has been organised. The result is that a large proportion of boards are leaving FidoNet to set up an alternative network.

Apparently, the plan is to provide gateways to FidoNet, giving sysops the ability to sort the wheat from the chaff. For most users, the only real impact this will have is that network addresses may change as the new arrangements bed down.

This month's listings were compiled with help from Gary Blythe, Larry Lewis, David Looke, Martin Tregale and Andrew Webster.

New systems

NSW

3M Australia (02) 498 9184. P. Graham Stair. 5pm-7am weekdays, 24 hours weekends. V21, V22, V22bis, Bell 103, 212. FidoNet 711/403.2.

Amiga Link (02) 953 7020. MV. Ross Delaforce. V21, V22, V22bis, V23, Bell 103, 212.

Baud Walk (02) 868 5885. MV. Gary Blythe. 24 hours daily. V21, V22, V22bis, V23. GTnet 036/007.

Caamora Systems (02) 630 6591. MV. Jonathan Michaels. V21, V22, V22bis, V23. FidoNet 713/610.

Intersoft (02) 476 2391. MV. Craig Heading. V22, V22bis.

Shortwave Possums (02) 651 3055. P. Patrick McDonald. 10pm-7.30am daily. V21, V22, V22bis. FidoNet 713/605.

Amiga Man (047) 58 8006. MV. Ron Carruthers. V21, V22, V22bis, V23.

Small Business (049) 50 4211. Geoff Bilborough. V21, V22, V22bis, V23.

Vic

AIM (03) 592 3338. MV. David Hellwege. V22, V22bis. FidoNet 633/361.

Comet (03) 211 0079. Caulfield High School. V21, V22.

Electric Dreams (03) 813 1663. Peter Studley. V21, V22.

Graveyard (03) 791 2175. 'The Beast'. V21, V22, V22bis, V23. 6pm-6am daily.

Kelly Gang (03) 484 0186. Shane Hurenkamp. Wednesdays ONLY, from 5pm.

MicroWay Source (03) 555 4932. David Waddell, David Looke. V21, V22, V22bis, V23, Bell 103, 212.

Witch's Brew (03) 718 2198. MV. Erika Matlen. 24 hours daily. V21, V22, V22bis, V23 (NetComm 1234).

Qld

BrisBug (07) 841 1768. Ron Lewis. V21, V22, V22bis, V23, Trailblazer. FidoNet 640/801.

SA

Bureau (08) 218 2002. P. Patrick Browne. V21, V22, V23.

Hackers Retreat (08) 250 5266. P. John Wave. 6pm-6am daily. V21, V22, V23. FidoNet 681/857.

WA

Paragon Computers (09) 325 5160. P. V21, V22, V22bis, V23.

Updates

NSW

Amstrad (02) 981 2966. M. Riccay Schmahl. V21, V22, V22bis, V23. FidoNet 714/903.

Bad News Travels Fast (02) 540 1879. MV. James Stevenson. V21, V22, V22bis, V23.

CoCo Arena (02) 646 5573. MV. John Kelly. V21, V22, V23, Bell 103, 212. FidoNet 712/625.

Cavity (02) 675 1472. MV. Don Cunningham. V21, V22, V22bis. Formerly known as Cranial Cavity.

Cursor Contact (02) 637 8131. MV. John Kelly. V21, V22, V23.

Eagle One (02) 745 3190. MV. Terry Harvey. V21, V22, V23. FidoNet 712/704.

Fido Australia — believed offline; positive information would be appreciated.

Lost Tavern (02) 938 6836. Sean Murphy. V21, V22, V22bis, V23. FidoNet 714/902.

Milliway's (02) 357 7027. MV David Coucke. 9.30pm-7.30am daily. V21, V22, V22bis, V23, Bell 103, 212. FidoNet 712/306.

Pandemonium (02) 411 7642. MV. Mark Farnan. V21, V22, V22bis, V23, Bell 103, 212. FidoNet 711/414.

Program Paradise (02) 969 5861. M. Matthew Wood & Andrew Avery. 4pm-7am daily. V21, V22, V22bis, V23.

Scorpio (02) 621 7487. P. Russ Morrison. 24 hours daily. V21, V22, V22bis, V23. FidoNet 713/604.

Silent Running (02) 59 1093. M. Frank Sinatra. 2.30pm-7.30am Monday-Friday, 24 hours weekends. V21, V22, V22bis, V23.

Software Connection (02) 975 1006. MV. Graeme Nichols. 24 hours daily. V21, V22, V22bis, V23, Bell 103, 212. FidoNet 714/404.

Ventura Publisher (02) 449 0463. M. V21, V22, V22bis.

Your Computer — offline.

Library — offline.

Vic

Alloy (03) 560 3902. Robert Nagy. V21, V22, V22bis, V23. FidoNet 633/364.

Alpha Centauri — offline.

Anzugs (03) 563 2496. P. Gordon Castle. V21, V22, V22bis, V23. FidoNet 631/326.

Atlantis International (03) 277 6824. P. John Edwards. 24 hours daily.

AUSOM Apple II (03) 877 1990. P. Grahame Willis. 24 hours daily.

AUSOM Macboard (03) 435 9152. P. Greg Ward. 24 hours daily. V21, V22, V22bis, V23.

C64 — offline.

Clone Phone (03) 876 4118. Greg Naylor. V21, V22, V23. 8pm-11pm weekdays, 24 hours weekends.

Compusoft (03) 386 6019. MV. George Tsoukas. 24 hours daily. V21, V22, V22bis, V23, Bell 103, 212.

Custom Programming (03) 848 3331. MV. Alan Williamson. 24 hours daily. V21, V22, V22bis, V23, Bell 103, 212. FidoNet 632/340.

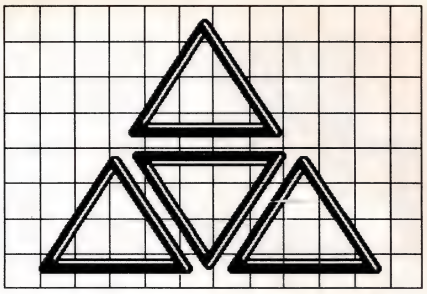
Cycom (03) 727 1018. Darren Huvsom. 6pm-6am daily. V21, V22, V23. FidoNet 631/328.

LiveWire (03) 399 9077. P. Ann Matthews. 24 hours daily. V21, V22, V22bis, V23.

MBUG (03) 882 9421. M. Mike Thompson. 24 hours daily. V21, V23. FidoNet 633/362.

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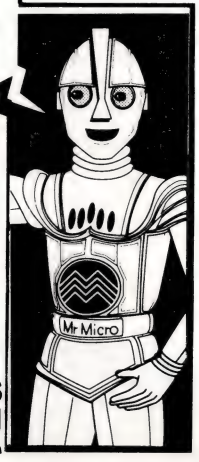
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Melbourne PIE (03) 878 5743. P. Len Gould. 24 hours daily. V21, V22, V22bis, V23.
PC Connection — offline.
Smart (03) 602 1336. MV. Richard Hoskin. V21, V22, V22bis, V23. FidoNet 633/368.
Zoist (03) 467 7984. M. Bob Fletcher. 24 hours daily. V21, V22, V22bis, V23 (Netcomm 1234SA). FidoNet 633/366.

Qld

Excalibur (07) 253 7917. P. Andrew Johnston. V22 only. FidoNet 640/220. Formerly known as Herston Experimental.
Mackay High — Temporarily offline.
Milliway's (07) 285 5814. MV. Goeff Ryan. 24 hours daily. V21, V23. Formerly known as Fix.
Sunshine Coast Connection (071) 44 2889. P. Brian Boseley. 8am-8pm Monday-Saturday, 24 hours Sunday. V21, V22, V22bis, V23. FidoNet 640/401.

SA

ADAM (08) 270 2455. MV. Greg Hicks. V21, V22, V22bis, V23. FidoNet 680/805.
Club — offline.

WA

The Gathering (09) 272 4711. Ken Peters. 24 hours daily. V21, V22, V23. FidoNet 691/611.
Hotel (09) 325 4752. P. Rod Evans. V21, V22, V22bis, V23. FidoNet 691/612.
Kardinya (09) 331 1695. MV. Tony Salmeri. V21, V22, V23, Bell 103, 212.
Mini Omen (09) 279 8555. Greg Watkins. V21, V22, V23. Formerly known as Omen Mini.
Pegasus (09) 344 8025. P. Michael Russell & John Chin. 5pm-9am weekdays, 24 hours weekends. V21, V22, V22bis, V23. FidoNet 692/620.
Perth Omen (09) 276 2777. MV. Mark Dignam. 24 hours daily. V21, V22, V22bis, V23. Formerly known as Omen III.
Terminal (09) 389 8048. P. Andrew Milner. V21, V22, V22bis, V23, Bell 103, 212.

Tas

Hobart Users (002) 43 5041. MV. Alan Hughes. V21, V22, V23. FidoNet 670/700.
Tassie Bread Board System (003) 26 4248. MV. Ian Campbell. 24 hours. V21, V22, V22bis, V23. FidoNet 670/751.

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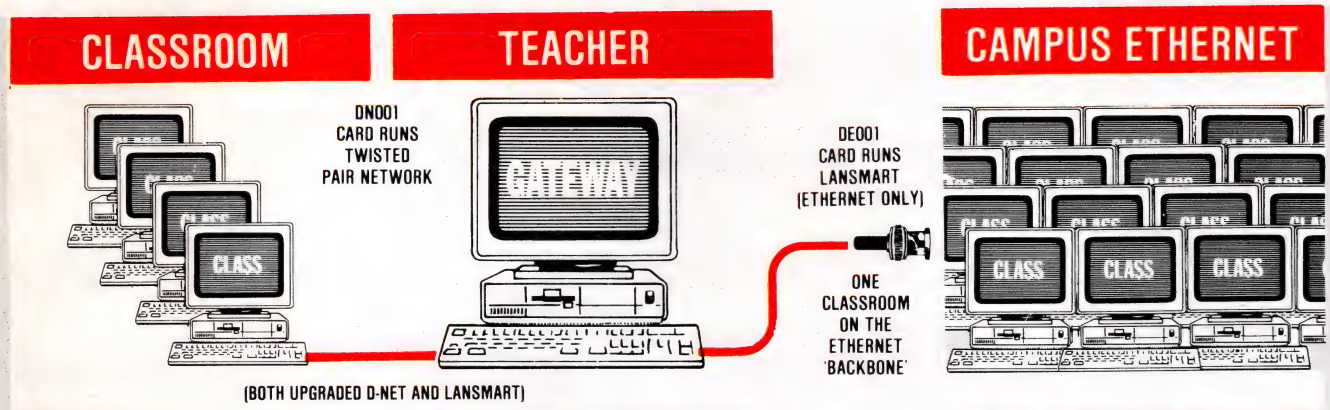
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Conferences/Meetings

October

4 **Finite Element Analysis in Structural Design** Dean Genner will discuss and demonstrate, where appropriate, the practical value of finite element applications software. *Enquiries, ACADS, tel: (02) 929 8097*

7-8 **Tadsem '88** This Australasian seminar on computers serving people with disabilities is well worth your attendance. There is a call for papers and the venue is the QE II Centre, Camperdown, Sydney. *Enquiries, tel: (02) 808 2022*

9-14 **The First World Congress of Prime Users** To be held at the Conrad International Hotel on the Gold Coast. *Enquiries, Koncepts, tel: (02) 957 5102*

12-14 **Suga '88** The fourth annual conference of the SAS User Group of Australia will be held at the Sydney Convention and Exhibition Centre, Darling Harbour. Don't miss it! *Enquiries, SAS Software, tel: (02) 908 2244*

13-14 **Deregulating Telecommunications Conference** This intensive two-day conference will bring together all the key players (suppliers, carriers, users, union, government) from Australia, New Zealand, Britain and Europe. *Enquiries, MTE, tel: (03) 670 7117*

25-27 **Aptex/API Conference and Forum 1988** An opportunity to hear and meet the experts at the jointly-held Aptex Australian Productivity and Technology Conference and the API Australian Process Industry Forum to be held in Sydney. *Enquiries, Richard Glover, tel: (02) 467 1949*

26-28 **International Pick Spectrum** To be held at Centrepoint in Sydney. *Enquiries, Caroline Bennett, tel: (02) 412 7144*

November

11 **Seminar on International Telecommunications** An all-day seminar will be held at the Toronga Centre, Toronga Park. The event is being co-hosted by ATUG and INTUG. *Enquiries, Marguerite Rona, tel: (02) 957 1333*

21-23 **Advanced User Interface Workshop and Seminar** This workshop and seminar is aimed at software engineers and developers and users of interactive information processing systems. Participants will be given valuable hands-on experience of various current systems. *Enquiries, tel: (03) 344 5230*

Exhibitions

November

3-5 **MacWorld '88** MacLovers, organise your pilgrimage to the MacMecca at Sydney's Darling Harbour. *Enquiries, tel: (02) 959 5555*

6-10 **International Symposium and Exposition on Robots** The use of robots in manufacturing and industry will be key applications discussed at the International Symposium and Exposition on Robots being held in Sydney. *Enquiries, Michael Kassler, tel: (02) 959 3239*

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Training

October

10-11 **Dataflex for Programmers and Analysts** This course is available at introductory, intermediate and advanced levels in Melbourne, Sydney, Adelaide and Perth. *Enquiries, MTE, tel: (02) 261 5555*

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17-18 **Electronic Data Interchange** From the EDP Manager to the Senior Executive, this course beckons to anyone involved in planning or implementing corporate networks, inter and intra company communications. *Enquiries, MTE tel: (03) 670 7117*

18-19 **Supporting PC Hardware** A course discussing hardware and add-on peripherals for non-engineers and non-technicals. *Enquiries, MTE, tel: (03) 670 7117*

END ZONE

NUMBERS

Some primes are rare, but some are very rare, as Mike Mudge explains.

Trivial thought: the rarest type of prime number is the even prime number! There is only one and its value is 2.

Sierpinski Primes These are of the form $p_s = n^n + 1$ and were first considered in 1958. Only two are known, 5 and 257. It is known that any others have more than 3×10^{10} digits. Are there (infinitely) (m)any others?

Wilson Primes These satisfy $(p_w - 1)! \equiv -1 \pmod{p_w}$; where n! = 1x2x3x4x5 . . . xn and $a \equiv b \pmod{c}$ means that a – b is an integer multiple of c.

Only three are known, 5 and 13 having been added to in 1953 (Goldberg) by 563. Keller has searched up to 3×10^6.

Are there (infinitely) (m)any others?

Wieferich Primes These satisfy $2^{p_{WH}-1} \equiv 1 \pmod{p_{WH}^2}$. Only two are known, 1093 (Meissner, 1913) and 3511 (Beeger, 1922); in 1981 Lehmer searched up to 6×10^9.

Are there (infinitely) (m)any others?

Cullen Primes These are of the form $p_c = n \times 2^n + 1$ and six are known: the corresponding values of n being 1; (Robinson 1958) 141; (Keller 1984) 4713, 5795, 6611 and 18496.

Are there (infinitely) (m)any more?

Sophie Germain Primes These are primes p_{SG} such that $2xp_{SG} + 1$ is also prime.

Note If p is a Sophie Germain Prime then there are no integers x, y and z, different from zero and not multiples of p such that: $x^p + y^p = z^p$.

Are there infinitely many?

Associated Cullen Primes These are of the form $P_c^* = n \times 2^n - 1$ and six are known: the corresponding values of n being 2,3,6,30,75 and 81.

Are there (infinitely) (m)any more?

Problem Readers are invited to construct computer programs to investigate primes of the general form:

$$p = a \times b^n \pm c$$

Particular emphasis should be placed on c = 1, b = 2 with values of 'a' including 3,5,7,9,11,17,19,21,33,45 and 57. However, $a = k^2$ and $a = k^4$ with b = 2 and c = 1, also b = 10 and c = 1 are of interest.

Note with b = 2, n must be greater than 1, otherwise the well-trodden path of Mersenne Primes will be followed.

Test data $17 \times 2^n + 1$ is prime when n = 3, 15, 27, 51, 147, 243 . . .; $45 \times 2^n - 1$ is prime when n = 1,2,3,4,5,6,8,9,14,15 . . .

Problem II What is the most efficient algorithm for listing the Sophie Germain Primes referred to above? How do these appear to be distributed within the set of all primes? Does this apparent distribution suggest an infinite number of these (female) primes?

Readers are invited to send their attempts at solutions to these problems to Mike Mudge, c/-124 Castlereagh St, Sydney 2000, to arrive by October 17, 1988. It would be appreciated if such submissions contained a brief description of the program and a summary of the results obtained in a form suitable for publication in *APC*.

These submissions will be judged using subjective criteria, and a prize will be awarded by *APC* to the 'best' contribution received by the closing date.

Review: April

The results on the computation of p(x) are summarised by Paulo Ribenboim, 'The Book of Prime Number Records', Springer-Verlag, 1988, culminating with $p(4x10^{16}) = 1075292778753150$.

This book provides the ultimate source of information, at the present time, for any reader interested in Prime Number results and related topics. Numerous readers computed p(x) up to at least $x = 10^8$. . . with or without error, but there was little interest in the efficiency of the computation. Perhaps 'dummy costing' should be introduced into personal computing to provide a motivation for efficiency?

The nearly pattern involving palindromic squares prompted a number of interesting replies, the most detailed of which was from David Poyner. David defined an algorithm to derive successive values in the progression and established how the arrival of the impermissible 'digit 11' at the eighth stage was responsible for the pattern breakdown. David is the worthy winner of this month's prize.

END

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or specific, for future Numbers articles; all letters will be answered in due course.

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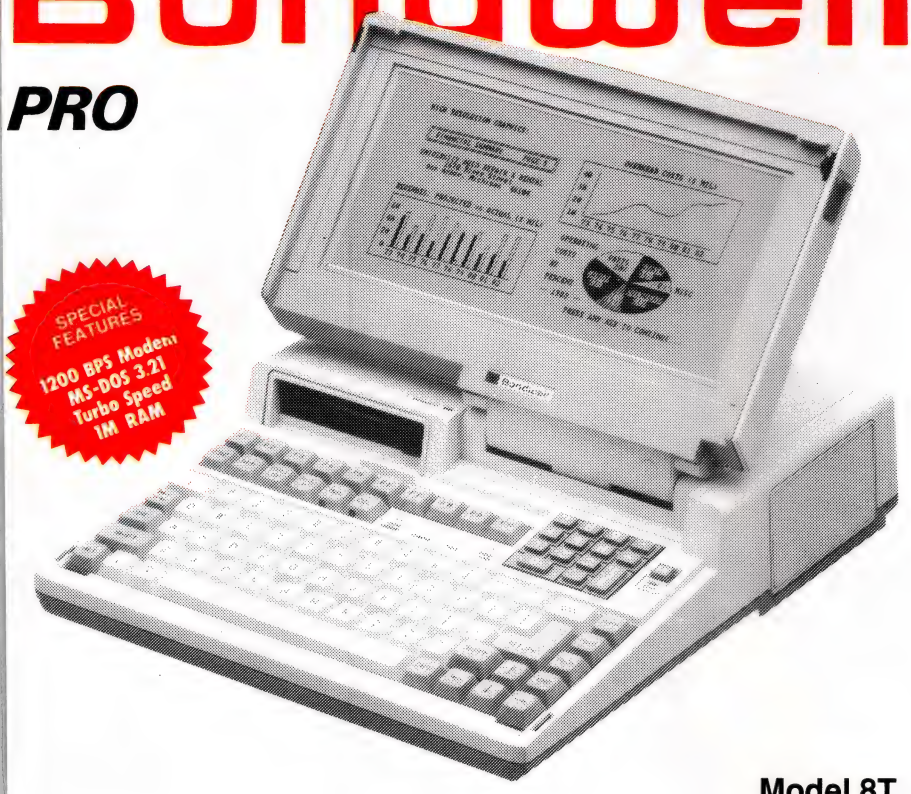
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LAZING AROUND

Brainteasers courtesy of JJ Clessa.

Quickie

My thanks to Miss Louise Sparnon for this month's neat little quickie.

Make a five-letter word using all the letters H I J K L M N O. Ugh — that's a pretty tasteless problem, isn't it?

Prize puzzle

Now from the ridiculous to the sublime. Using only the 10 two-digit primes less than 45 (that is, 11, 13, 17 . . . up to 43) how many combinations of three or more of these added together give a total which exceeds 100?

For example:

(a) 11 + 13 + 17 + 19 + 23 + 29 + 31 + 37 + 41 + 43

(b) 43 + 41 + 37

(c) 11 + 23 + 29 + 41 + 43

are all such permissible combinations. How many are there altogether?

Answers on postcards only (or backs of envelopes) to reach us not later than October 31, 1988.

Send your entries to: Lazing Around October, *APC*, 124 Castlereagh Street, Sydney 2000.

July prize puzzle

A limited entry to the logical puzzle. All except three of the 50 entrants correctly deduced that the fourth native was a 'Verity'.

However, there was only one winner drawn and that card came from Tony Crisp of Glen Waverley. Mr Crisp, your prize is on its way.

As one or two entrants pointed out, the problem was not really one for the micro solution, but we like to introduce this type of puzzle occasionally merely to widen the mix. Many entrants do ask for logic puzzles.

Finally, we are still receiving cards offering 'solutions' to the four 7's problem. Can we repeat that you may only use the four 7's plus standard (that is: universally acclaimed) mathematical symbols: 'Log', 'e', 'π' and the like are not considered to be symbols. Factorial (!) is OK, but it means 'the product of' and not 'the sum of' as some readers claimed.

We believe that no solution is possible for the value 26, but keep trying if you must.

END



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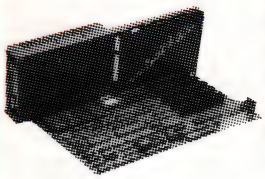
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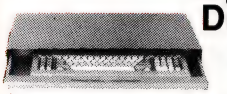


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VGA card	$720
VGA Monitor	$950

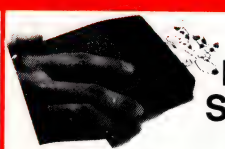
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USER GROUPS

Below is the list of hardware user groups from our full User Group listing. Any updates or additions should be sent to 124 Castlereagh Street, Sydney 2000.

NSW

The APL User Group meets on the third Wednesday of each month at IP Sharp Associates, 8th Floor, 55 Elizabeth Street, Sydney. Activities include lectures, tutorials, and demonstrations.

For further information contact the Secretary, John Hamilton, GPO Box 1425, Sydney 2001. Tel: (02) 227 5981.

Apple User Group holds two meetings per month. The Macintosh General Meeting and Apple II Special Interest meetings are held on the first Monday of each month; and the Apple II General Meeting and Macintosh Special Interest meetings are held on the second Monday of each month. Meetings are held in the Stephen Roberts Theatre at the University of Sydney, commencing at 6.00pm. Activities include group discussions, special interest groups, bulk purchases, bulletin boards, and they also have a library of software, shareware and various sample/demonstration programs.

For further information, contact Graham Clark, PO Box 505, Bankstown 2200. Tel: (02) 958 2709.

The Australasian Microcomputer User Group meets on the third Monday of each month at the Crows Nest Club, Hayberry Street, Crows Nest, commencing at 7.00pm. Activities include training programs, helping smaller business people and newcomers to computers.

For further information contact John Rigby, PO Box C530, Clarence Street, Sydney 2000. Tel: (03) 913 2113.

The Bathurst Computer Group meets on the second and fourth Friday of each month (during school terms) at the West Bathurst Public School, Suttor Street, Bathurst.

For further information contact the President, Gary Douglas, PO Box 1104, Bathurst 2795. Tel: (063) 31 6702.

BBC User Group of Sydney — see Ozbeeb the Acorn.

The East Coast Amiga Group holds three meetings. The Amiga group meets on the second Friday of each month at the Wyong Community Centre, Cnr Alison and Rankin Streets, Wyong; and the fourth Friday of each month at the Niagara Park Public School, Narara Valley Drive, Niagara Park.

The 64/128 group meets on the second Tuesday of each month at Niagara Park Public School. Activities include tutorials, software and hardware demonstrations, public domain software.

For further information contact the Secretary, PO Box 86, Umina 2257. Telephone Jeff Campbell (043) 41 8140 or Dick Bridge on (043) 23 2179.

The Macarthur Computer User Association meets on the first Monday of each month (except January). Activities include workshops, presentations, demonstrations and excursions. They also hold courses, hire equipment and bulk buy certain computer items.

For further information contact Ian Douglas, 10 Ulmarra Avenue, Camden 2570. Tel: (046) 66 6463.

Ozbeeb the Acorn and the BBC User Group of Sydney meet on the second Wednesday of each month at Barson Computers, North Ryde; and the fourth Monday of each month at Marist Boys High School, West Mead. Activities include demonstrations, talks, user's forum links with hardware/software houses.

For further information contact Alan Jones, PO Box 1030, Parramatta 2150. Tel: (02) 635 4868.

The Sorcerer User Group meets at the Greenwich Community Centre, 46 Greenwich Road, Greenwich. Activities include demonstrations, discussions, and weekend seminars. The group also has a library of public domain software, publish a newsletter, and a bulletin board.

For further information contact the President, S Mannasz, PO Box E162, St James 2000. Bulletin Board (02) 626 8020.

The Sydney Commodore User Group, Sydcom, meets on the second Friday of each month, and holds workshops on the third Friday of each month. Meetings and workshops and are held at the Ryde Catering College, 250 Blaxland Road, Ryde, commencing 7.30pm. The group caters for users of all Commodore computers and publishes a regular newsletter.

For further information contact the Secretary, Ian Langton, GPO Box 1542, Sydney 2001. Tel: (02) 810 3257.

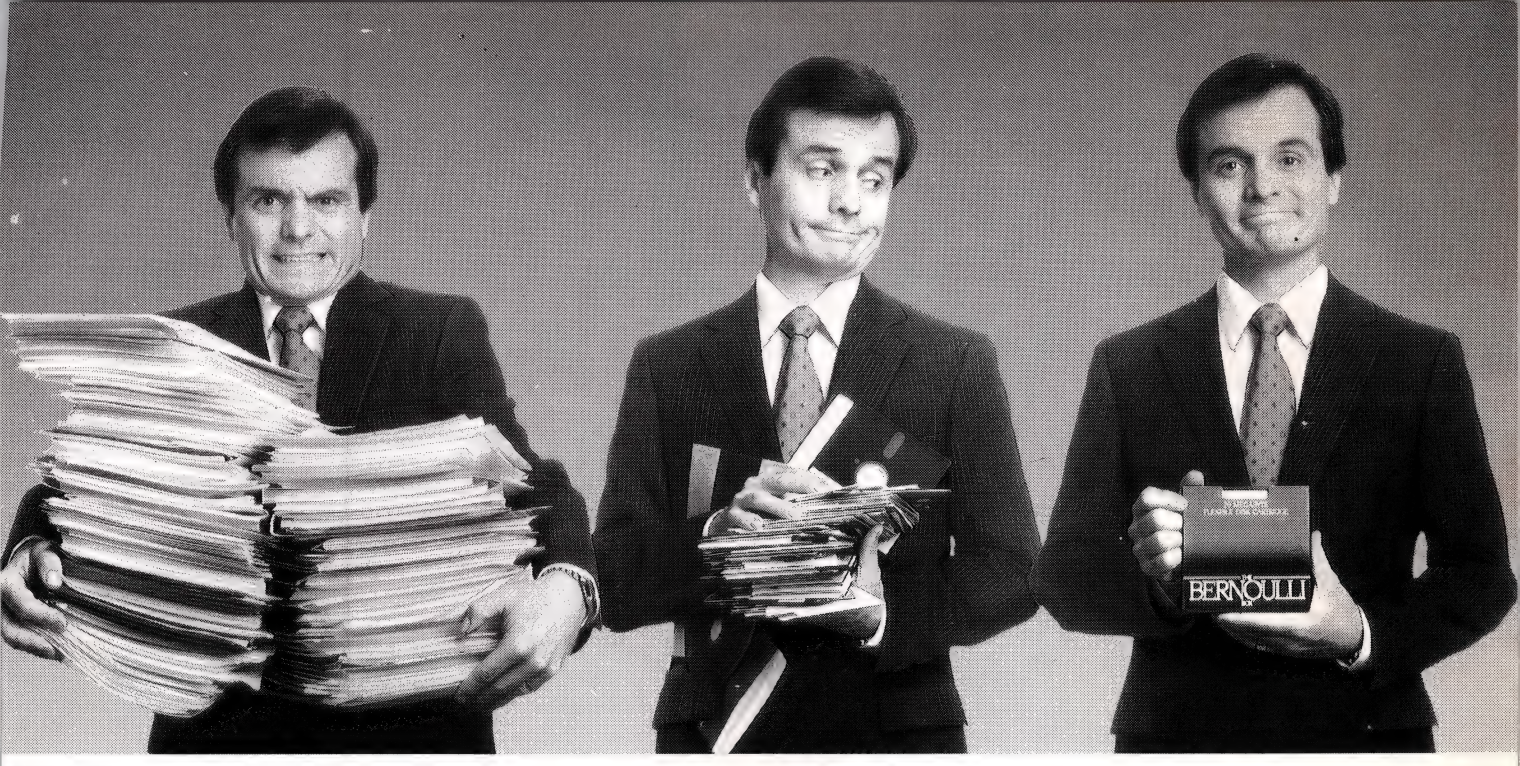
The Sydney Kaypro User Group meets on the second Tuesday of each month at the Burwood RSL Club, Shaftesbury Avenue, Burwood, commencing 7.30pm. Activities include help with hardware and software, MS-DOS/CP/M. The group also maintains a software library and publish a regular newsletter.

For further information contact Hans Schneider, PO Box 63, Concord 2137. Tel: (02) 309 2961.

Sydney Macintosh User Group — see Apple User Group (Sydney).

The Sydney Microbee User Group meets on the third Saturday of each month at Strathfield Girls High School, Albert Road, Strathfield. Activities include demonstrations, sale of public domain software and exchange of information.

For further information contact the Secretary, Peter Wagner, PO Box C233,



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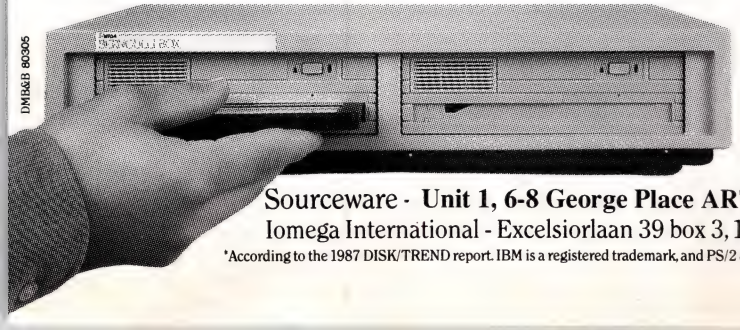
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Clarence Street, Sydney 2000. Tel: (02) 86 4575.

The Western Sydney Macintosh User Group (WESTMUG) meets on the third Wednesday of each month at the Nepean College of Advanced Education in the Macintosh Computer Room, Kingswood, commencing at 6.30pm. Activities include workshops, assistance with software/hardware problems and demonstrations.

For further information, contact the Acting Secretary, Paul Talbert, PO Box 523, Penrith 2750. Tel: (047) 21 9407 bh or (047) 35 2115 ah.

VIC

The Amiga User Group meets on the third Sunday of each month at the Rotunda, Monash University, Wellington Road, Clayton, commencing at 2.00pm. Activities include demonstrations, special interest groups and Amigalink BBS. The group also maintains a public domain library and a book and magazine library.

For further information contact the Secretary, J Elston, PO Box 48, Boronia 3155. Tel: (03) 879 2322 BH.

The AZUAVIC User Group meets on the third Wednesday of each month at the Mount Waverley Community Centre, Cnr Stephensons Road and Miller Crescent, Mount Waverley, commencing at 7.00pm. Activities include information interchange, demonstrations, assistance with repairs, support for Sinclair computers, ZX81, Spectrum and QL. The group also publishes a monthly newsletter.

For further information contact Cliff Restarick or Paul Peeler, 208 Kooyong Road, Caulfield North 3161. Tel: (03) 528 2539 CR or (03) 596 3370 PP.

The KAOS Computer User Group meets on the first Sunday of each month (except January), at the Sandown Scout Hall, Dowling Avenue, Springvale, commencing 1.00pm; and on the last Sunday of each month (except December), at the Senior Citizens Club, Munro Street, Ascot Vale, commencing at 1.00pm. Activities include assistance in running software and customising hardware; the group publishes a monthly newsletter.

For further information contact John Whitehead, 17 Frudal Crescent, Knoxfield 3180. Tel: (03) 763 5983 ah.

The MBUG Australia User Group meets on the second and fourth Wednesday of each month. Activities include information interchange and demonstrations.

For further information contact Andrew Barfoot, PO Box 157, Nunawading 3131. Tel: (03) 758 4822.

The Melbourne Atari Computer Enthusiasts meets on the second Sunday of each month (except January) in the Rotunda Building, Monash University, commencing at 10.30am. Activities include music/MIDI interest group, screen art, beginner's corner, and adventuring.

For further information write to PO Box 340, Rosanna 3084. BBS: (03) 899 6203.

The Melbourne Color Computer Club meets on the first and third Tuesday of each month at the corner of Dandenong Road and Chapel Street, St Kilda, commencing at 7.30pm. Activities include learning Base OS-9 and assembly language.

For further information contact the Secretary, Les Leishman, 282 St Georges Road, Northcote 3070. Tel: (03) 484 0822.

The Melbourne Commodore Computer Club meets on the third Wednesday of each month at the Nunawading Civic Centre, Whitehorse Road, Nunawading, commencing at 7.30pm. Activities include demonstrations, discussions, exchange of information and problems. The group also maintains a public domain library for VIC 20, C64/128.

For further information contact Chris Franks, PO Box 177, Box Hill 3128. Tel: (03) 758 5529.

The Melbourne PC User Group meets on the first Wednesday of each month (except January) at the Clunies Ross House, 191 Royal Parade, Parkville, commencing at 6.00pm. The group also holds an average of 14 meetings during each month, covering different areas.

For further information contact the Secretary, David Owen or the Administrative Officer, David Sloan, GPO Box 1728P, Melbourne 3001. Tel (03) 642 1234 DO or (03) 699 1943 DS.

The Microcomputer Club of Melbourne meets on the third Saturday of each month at the Burwood Campus of Victoria College, Building E, 221 Burwood Highway, Burwood, commencing at 1.00pm.

For further information contact Donald Riley, PO Box 60, Canterbury 3126. Tel: (03) 544 5444 bh.

The Northwest Amiga User Group meets on the second Wednesday of each month at the Essendon Community Centre, Mt Alex Road, Moonee Ponds, commencing at 7.30pm. Activities include demonstrations, new products, question and answer sessions.

For further information contact the Treasurer, Simon Sheed, 4/25 Liverpool Street, Coburg 3058. Tel: (03) 383 4905.

The Spectravideo and MSX User Group meets on the first Saturday of each month at the Nunawading Civic Center, G.J. Wills Room, Whitehorse Road, Nunawading, commencing at 1.00pm.

For further information, contact the President, Mitch Raitt, 68 Grassy Flat Road, Diamond Creek 3089. Tel: (03) 438 2687.

The Tandy MS-DOS User Group meets on the second Monday of each month at 2 Cole Street, Hawthorn East, commencing at 8.00pm. All users of MS-DOS, IBM compatible computers are welcome.

For further information contact the President, Tony Lloyd. Tel: (03) 882 4664 BH.

The Victorian Osborne User Group meets on the fourth Sunday of each month at the Ashburton Public Library, 152 High Street, Ashburton, commencing at 2.00pm. Activities include workshops, presentations, public domain software library.

For further information contact Geoff Cartwright, PO Box 169, Camberwell 3124. Tel: (03) 459 8934.

The Yarra Valley User Group meets on the first Tuesday of each month at the Melba Hall, Castella Street, Lilydale, commencing at 8.00pm.

For further information contact the Secretary, PO Box 176, Lilydale 3140. Tel: (03) 735 0638 B Vickers.

QLD

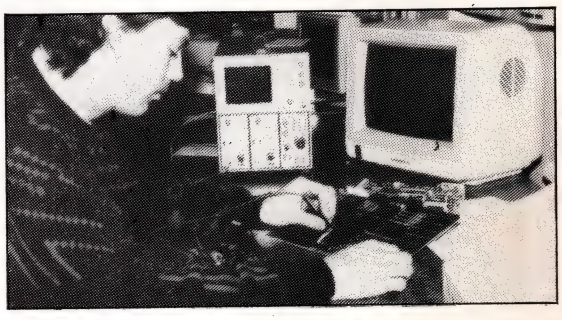
The Apple-Q User Group meets on the third Sunday of each month (excluding December) at the Hooper Centre, Kuran Street, Wavell Heights, commencing at 9.00am. Activities include interchange of information, guest speakers, and classes in M/L.

For further information contact the Secretary, R. Godbehere, PO Box 721, South Brisbane 4101. Tel: (07) 808 3892.

The Brisbane Sixteen Bit User Group (Brisbug) meets on the third Sunday of each month at the Toowong High School, Bywong Street, Toowong, commencing at 2.00pm. Activities include sharing information, distribu-

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tion of public domain software, and helping each other.

For further information contact the President, Ian Patterson, PO Box 985, Toowong 4066. Tel: (07) 356 5891.

The Cairns Commodore User Group meets on the first and third Tuesday of each month at the Cairns Education Centre, commencing at 7.30pm. Activities include demonstrations and workshops. The group also maintains a public domain and book library.

For further information contact Ian Pearse, PO Box 7, Earlville 4870. Tel: (070) 54 4514.

The Commodore Computer User Group meets on the first Tuesday of each month (except January) at the Bardon Professional Development Centre, 390 Simpsons Road, Bardon, commencing at 7.30pm. Activities include suburban workshops.

For further information, write to PO Box 274, Springwood 4127. BBS 24 hours (07) 344 1833.

The CompuColour User Group meets on the third Saturday of each month at 325 Enoggera Road, Newmarket 4051, commencing at 1.30pm.

For further information contact Ray Halliday, 325 Enoggera Road, Newmarket 4051. Tel: (07) 356 4236.

The Gold Coast Atari User Group meets on the third Sunday of each month at the Southport State School, corner of Scarborough and Lawson Streets, commencing at 3.00pm.

For further information contact Allan Robinson, 42 12th Avenue, Palm Beach 4221. Tel: (075) 57 3632.

The Sharp User Group of Brisbane meets on the second Wednesday of each month at Graceville State School, Oxley Road, Graceville. Activities include instruction and use of Sharp computers, use of library facilities, publishing a monthly newsletter, and liaison with English groups.

For further information contact Bill Laidlaw, 51 Sandon Street, Graceville 4075. Tel: (07) 379 3457.

The University of Queensland Osborne User Group meets on the second Thursday of each month (except January) at the Psychology Department, University of Queensland, commencing at 7.00pm. Activities include maintenance of public domain software, education of members, maintenance of CPM section of bulletin board.

For further information contact Neal Ashkanasy, Commerce Department, University of Queensland, St Lucia 4067. Tel: (07) 371 4294.

SA

The Hitachi User Group is a special interest group of the SA Micro Processor Group. Meetings are held irregularly at various locations.

For further information contact Cliff Hignett, 45a Ormond Avenue, Daw Park 5041. Tel: (08) 276 7706.

The Microbee User Group of SA meets on the third Monday of each month at 18 Arthur Street, Unley, commencing at 7.30pm. Activities include support for CP/M and MS-DOS.

For further information contact the Secretary, PO Box 767, Adelaide 5001.

The South Australian Apple User Club (SAAUC) holds two meetings per month. The general meeting is held on the first Friday of each month at the rear of the Prospect Town Hall, commencing at 7.30pm. The Mac Special Interest Group meets on the third Friday of each month at the same venue. Activities include demonstrations, question and answer sessions, publishing a monthly newsletter, and a selection of public domain software is available.

For further information, contact the Secretary, Ian Bagust, PO Box 322, Prospect 5082. Tel: (08) 293 7183.

The Adelaide Atari Computer Club meets on the first Monday of each month (or second if it clashes with a public holiday) at Gilles Street Primary School, commencing at 7.30pm; and the third Monday of each month at Modbury West Primary School, again commencing at 7.30pm. Activities include demonstrations, discussions, publishing a club magazine, maintaining a public domain and magazine library.

For further information contact the Secretary, Bob McEwin, PO Box 333, Norwood 5067. Tel: (08) 263 8854.

The Sorcerer User Group meets on the second Wednesday of each month at MAC Audio and Acoustical Consultants, 54-56 Goodwood Road, Goodwood. The group publishes a monthly newsletter, and provide a bulletin board service.

For further information contact the Secretary, Don Ide, 14 Scott Road, Newton 5074. Tel: (08) 260 6576.

WA

The Amstrad Amswest User Group meets on the first and third Tuesday of each month at 238 Bagot Road, Subiaco. Activities include educating members to understand and operate Amstrad computers.

For further information contact Graeme Worth, 6/54 Central Avenue, Maylands 6051. Tel: (09) 341 5211.

The Australian QL User Association meets occasionally.

For further information contact Richard Czerwonka, 17 Tucker Street, Capel 6271. Tel: (097) 27 2361.

The Microbee User Group of WA meets on the first Sunday of each month at the Leederville Technical College, commencing at 7.30pm. Activities include guest speakers, hardware and software hire.

For further information contact Ross Gould, GPO Box N1090, Perth 6001. Tel: (09) 417 1374.

ACT

The Canberra Compucolour Club meets irregularly, but serves as contact point for local and interstate users. The Club has considerable software and information on hardware mods and problems related to the Compucolour.

For further information, contact the convenor, Ken Kerrison, 5 Beltana Road, Pialligo 2609. Tel: (062) 47 6575.

The Canberra NEC User Group meets on the first Tuesday of each month at the Bureau of Meteorology, 84 Northbourne Avenue, Canberra, commencing at 7.30pm. Activities include lectures, discussions, monthly newsletter.

For further information contact the President, Brian Embury, PO Box 173, Belconnen 2616. Tel: (062) 59 1115.

The PC User Group meets on the last Monday of each month at the Coombs Lecture Theatre, ANU Campus, commencing at 8.00pm. Activities include training courses, special interest groups, public domain software/hardware library, and publishing a monthly newsletter.

For further information contact the Secretary, Will Faithful, PO Box 2229, Canberra City 2601. Tel: (062) 58 7484.

TAS

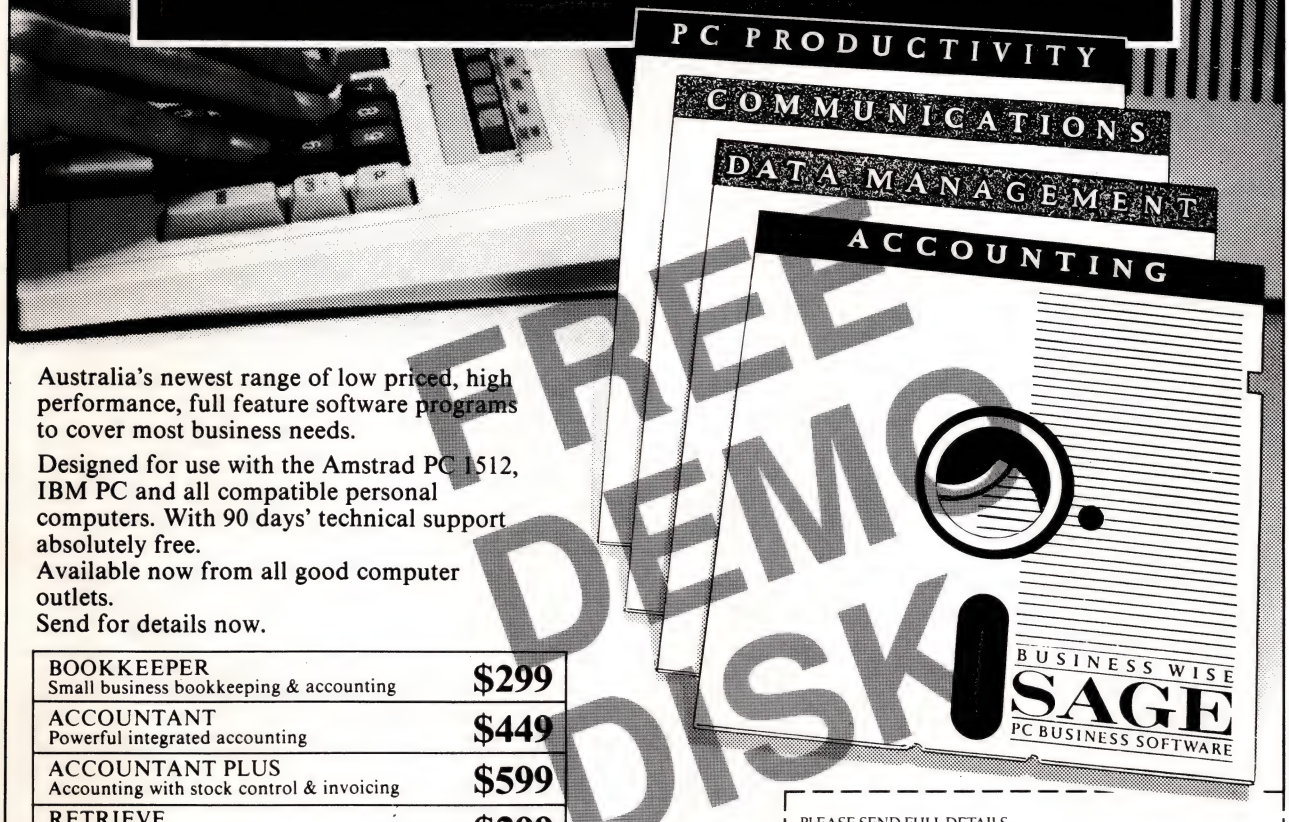
The Southern Tasmanian Amstrad Club meets on the fourth Wednesday of each month at the Derwent Regional Library, Glenorchy. The group gives assistance to CPC and PCW owners.

For further information, contact Frank Self, PO Box 247, North Hobart 7002. Tel: (002) 49 5499.

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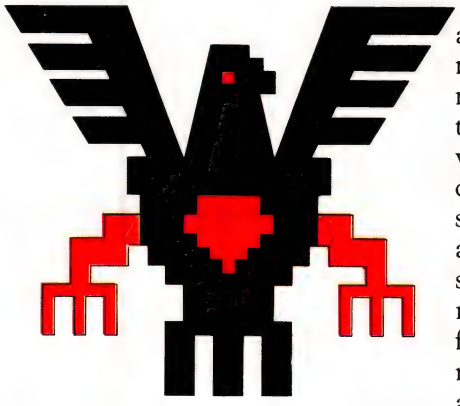
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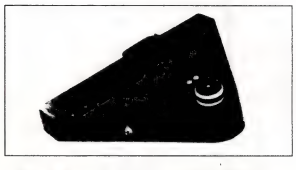
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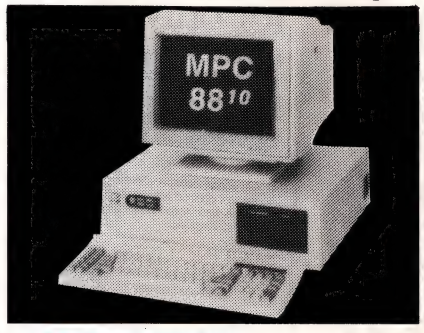
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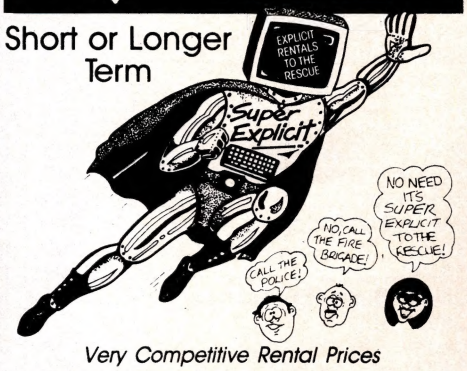
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Abacus Software 162
ABE Computers 308
Acer 97
ACS Supersonics 307
Advance Peripherals 246,247
Alfa Computer 124
Algar Burns Software 84
Allaw Sales OBC
Alloy 172
Alltek 279
Alpha Juno 306
Amstrad 28,29,43,45,46.47,65,159
Arcom Pacific 202
Asa Hi Computers 288
ASP Microcomputers 131
Atlantis International 178
Atronics International 269
Attache Software 197,50
Austral Data Networking 311
Australian Everex Systems 169
Australian Network Connections 87
Automated Office 308
Automation One 214
Avtek 119
Barson Computers 165
BJE Enterprises 108
Blue Chip Electronics 85
Bluejem Computers 143
Bootstrap 194
Boston Technology 276
Brylar 295
C&PA 309
Calmar Business Technology 196
Canon Aust IFC,1
Cartel 232,248
CATS 305
CC Data Computers 134
CC H Solvware 198
Centech 167
Character Software 200,222
Chien Hou 182
Choice Marketing 149
Chua Board
Chyi Tong 280
Comdek 185
CompuHelp Australia 19,21,23
Computer Capitol 267
Computer Discounts 284
Computer Electronics 262
Computer Enterprises 269
Computer Publications 245
Computer Shark 74
Computer Supermarket 303
Custom Computer Services 180,181
Custom Made Software 212
Dakomm 223,138
Data Peripherals/Hyundai 94
Dataedge 296
Dataparts 104,105
Delta Electronic 273
Diamond Systems 81
Dicker Data 174
Dick Smith 226
Digital Solutions 271
Dimension Graphics 137
Discware 238,239
Disk Media 304
DM Software 147
Doctor Disk 302
Dueltek 307
EME 60
Executive Systems (X-Tree) 80
Exogen Business Tools 179,201
Explicit Computer Rentals 309
Express Technology 265
Extra Tech 284
Famous 199
FBN Software 30,238
Flanour Business Systems 199
Flexible Systems 309
FMS 90,141,242
Formosa 280
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Freeware 219
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GT Computing 304
Hales & Rogers 18,102
Harbour Music 271
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Hearne Marketing Software 151
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ICT 91,93
Idea Associates 56,57
Ideal Graphics 306
Ideal Systems 195
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Intelligent Nexus Corp Board
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Interface Publications 306
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Kaypro 55
KCM 78,304
Keller Automation 106,107,116
Kookaburra 109
Kun Ying 188
Lazarus Ribbons 305
LogiCraft 14
Logicware 276
LogiSoft 81
Logo Computer Centre 48
Machine Language 304
Macro Dynamics 308
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Maestro 285
Mainstream Computers 100
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Management Control Systems 218
Marketworld 173,175,177
Martlett Software 16
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Micro Arts 307
Micro Australia 144,207
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Micro Pro Computers 253
Micro Sales 4,88,89
Micro Science Computers 294
Micro Station 307
MicroGram 289
Microland 76,77
Micromart 92
Micromart Board
Microshack 61
Microtek 153
Microway 71
Mike Boorne 142,281
Mitac 117
Monitech 273
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Natcomp Technology . 31,32,33,34,35,36
NEC 42
New Tech 283
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Paper Warfare 306
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PC Support 153
Perfect Interface 38,39
Peripheral Systems 51,52,53,54
Pitman Publishers 251
Porchester Computers 17,41
Practical Solutions 305
Pricom 176
Printer Wholesalers 230
Programs Plus 15
Qld Exhibition Service 20
Quarterdeck 98
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Quercus 146
RCS Design 308
Reckon Software 203,210
Replex 276
Ribbon Re-Inking 305
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Rod Irving Electronics 112,113,120,121,128,129
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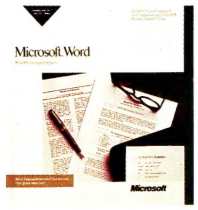
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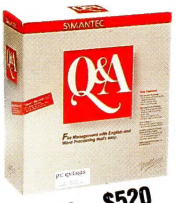
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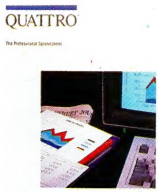




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